A1310-3 F 7/91

Monograph Series on
Tax and Environmental Policies & U.S. Capital Costs

# U.S. INVESTMENT TRENDS: IMPACT ON PRODUCTIVITY, COMPETITIVENESS, AND GROWTH

American Council for
Capital Formation
Center for Policy Research

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American Council for Capital Formation
Center for Policy Research

Washington, D.C.
April 1991

The American Council for Capital Formation Center for Policy Research was established in 1977 as the education and research affiliate of the advocacy-oriented American Council for Capital Formation. The Center's mandate is to promote an understanding by the public, policymakers, and opinion shapers of the importance of capital formation to the economy. To achieve its objective, the Center sponsors original research on the determinants of saving, investment, and economic growth; underwrites conferences and seminars on tax, budget, and international competitiveness issues; and assists in the development of alternative economic policies conducive to economic growth.

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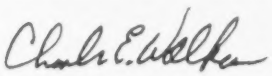
# INTRODUCTION

Is the rate of U.S. capital formation sufficient? What is the most appropriate measure of investment? To answer these questions, and to investigate the relationship between U.S. investment trends and economic growth, the American Council for Capital Formation Center for Policy Research sponsored a symposium on November 8, 1990. The symposium, entitled "U.S. Investment Trends: Impact on Productivity, Competitiveness, and Growth," was the third in a series of three roundtable discussions that the ACCF Center organized in 1990 as part of a special project on "Tax and Environmental Policies & U.S. Capital Costs."

This monograph contains the paper and responses prepared for the symposium as well as the luncheon address by Council of Economic Advisers Chairman Michael J. Boskin. The panel of experts agreed that while investment is difficult to measure, the growth rate of the net capital stock appears to be a more useful concept than yearly gross investment spending. The net capital stock grew more slowly in the 1980s than in earlier years, indicating that improving the climate for investment and economic growth, through tax policy changes and other measures, must be given high priority. We hope this monograph will prove useful to decision makers as they consider the fiscal-policy alternatives.

We extend our sincere thanks to the experts who participated in the November symposium and subsequently assisted in the preparation of this monograph. We also express our deep appreciation to the groups that provided financial support for the 1990 special project on "Tax and Environmental Policies & U.S. Capital Costs": American Business Conference; American Petroleum Institute; BankAmerica Foundation; Chemical Manufacturers Association; Clean Air Working Group; Exxon Company, U.S.A.; General Electric Company; The Henley League, Ltd.; Manufacturers' Alliance for Productivity and Innovation; National Venture Capital Association; Shell Oil Company; Thermo Electron Corporation; and Weyerhaeuser Company.

We look forward to sharing additional insights about the relationship between U.S. tax and environmental policies and economic growth through our symposium and publication programs in 1991, as we continue and broaden our investigation of this important subject.



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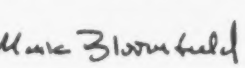

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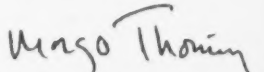

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# ABOUT THE PANELISTS

**Hon. Michael J. Boskin** is chairman of the president's Council of Economic Advisers. He was appointed to this post by President Bush, following Senate confirmation, on February 2, 1989. As chairman, Dr. Boskin provides economic analysis and advice directly to the president and assists in formulating national economic policies. He is on leave from Stanford University, where he is the Burnet C. and Mildred Finley Wohlford Professor of Economics and director of the Center for Economic Policy Research. Dr. Boskin is also on leave as a research associate of the National Bureau of Economic Research.

**Dr. Robert Gillingham** is deputy assistant secretary for economic policy, Department of the Treasury, a position he has held since September 1988. In addition to his five years of service at Treasury, Dr. Gillingham's seventeen-year federal government career includes senior positions at the Bureau of Labor Statistics. The author or coauthor of more than two dozen studies and journal articles, Dr. Gillingham has been associate editor of the *Journal of Business and Economic Statistics* since its inception in 1982.

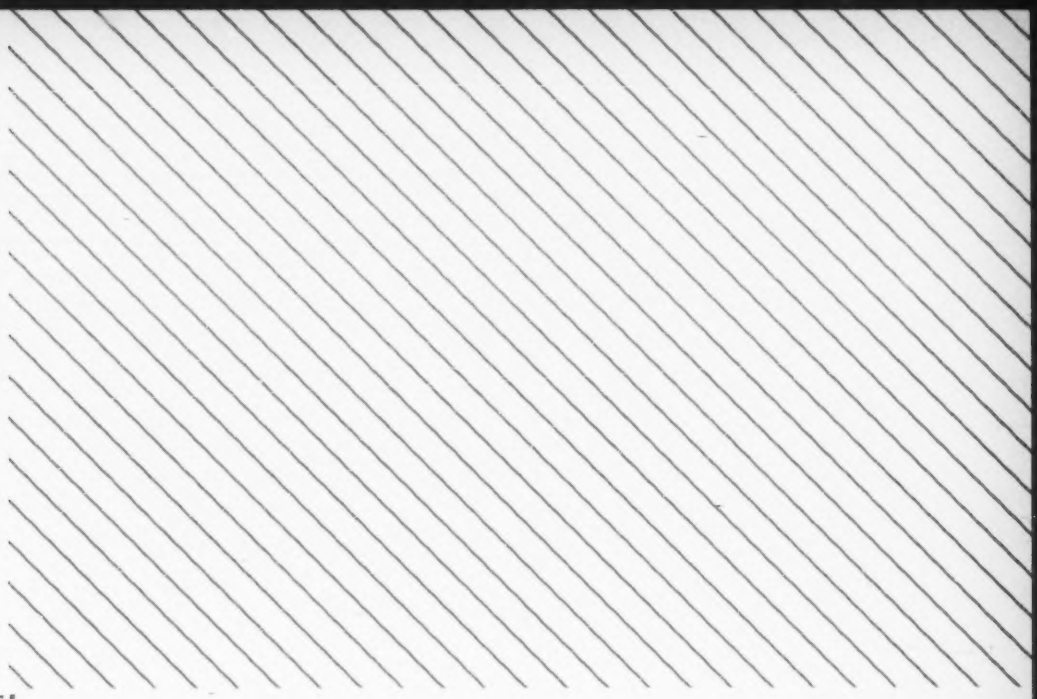
**Dr. Barbara N. McLennan** was appointed deputy assistant secretary for trade information and analysis in the Commerce Department's International Trade Administration in June 1989. Dr. McLennan oversees the office that analyzes trade data and provides statistical and analytical information on major trends in U.S. and world trade. Before joining the Commerce Department, Dr. McLennan was an international tax specialist and industry economist at the Internal Revenue Service and was a contributor to the 1984 Treasury Department report to the president concerning tax reform.

**Dr. Joel L. Prakken** is vice president of Laurence H. Meyer & Associates (LHM&A), a private consulting firm specializing in econometric modeling, forecasting, and policy analysis. He also serves as associate adjunct professor of economics at the Washington University School of Business in St. Louis. Before co-founding LHM&A in 1982, Dr. Prakken was senior economist at the IBM Corporation, where he was responsible for both long-term forecasting and the development of the IBM macroeconomic model. He has also been an economist with the Federal Reserve Bank of New York and an adjunct professor of finance at New York University's Graduate School of Business.

**Dr. Stephen S. Roach** is a principal and senior economist at Morgan Stanley & Co., Inc., where he has responsibility for the firm's forecasting and analysis of economic activity in the United States. Before joining Morgan Stanley in 1982, Dr. Roach was vice president, economic analysis, for the Morgan Guaranty Trust Company. Prior to assuming that position, he served for six years on the research staff of the Federal Reserve Board in Washington, D.C., where he supervised the regular preparation of the official staff pro-

jections of the U.S. economy. Dr. Roach's recent published work has covered a broad range of topics from technology and corporate debt to the consumer and capital spending.

**Dr. Charles Steindel** is a research officer in the Domestic Research Department of the Federal Reserve Bank of New York. In this position, Dr. Steindel administers a unit conducting macroeconomic research and economic forecasting, carries out research in macroeconomics, and prepares bank forecasts of U.S. economic activity. Prior to joining the Federal Reserve Bank of New York in 1985, Dr. Steindel worked at the First National Bank of Chicago for four years and earlier for four years at the Federal Reserve Board. He is the author or coauthor of numerous studies and journal articles on corporate and household debt, social security, saving, and capital formation.



# Recent Trends In Capital Formation

Charles Steindel

## INTRODUCTION

The long economic expansion has bought many benefits. In terms of aggregate data, the benefits are most visible in the dramatic increase in employment since 1982 and the sustained growth in per capita consumer spending and after-tax income. The expansion has also seen rapid growth in capital spending. From 1982 to 1989, inflation-adjusted spending on nonresidential plant and equipment grew 40 percent. As a share of real gross national product (GNP), investment spending averaged more than 12 percent in the late 1980s—a figure previously seen only twice in the postwar economy.

This impressive performance has led some commentators to argue that the United States is investing enough to sustain growth in per capita consumption at historic rates and, if necessary, to reverse the flows of international capital so the United States is once again a capital exporter.[1] The opposing point of view, however, argues that if outlays necessary to replace worn-out capital are taken into account, investment is at historically low rates. These weak *net* investment levels correspond to very weak growth in the net capital stock. Slow growth of capital today puts a low ceiling on the economy's ability to grow in the 1990s and deliver increases in living standards, especially when one takes into account a possible need to replace foreign capital inflows.[2]

In the next section of this paper ("Measuring Investment and Capital Input"), I discuss the relevance of annual investment flows and the capital stock data for economic growth. At an aggregate level, these measures *can* give divergent signals about the growth of economic capacity, and in certain special circumstances investment flows *may* be the more valid indicator. These special circumstances, however, do not appear applicable to the recent U.S. experience. Instead, the recent slowdown in capital stock growth appears to be contributing to a slowdown in the growth of economic potential.

In the final section ("Empirical Estimates of Capital Formation"), I discuss in some detail the data on U.S. capital formation by industry and type. The data show that the slowdown in capital stock growth has been particularly evident in manufacturing and in the specialized capital types used by manufacturers.

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The help of William May is gratefully acknowledged. The views expressed here are those of the author only and do not necessarily reflect those of the Federal Reserve Bank of New York or the Federal Reserve System.

## MEASURING INVESTMENT AND CAPITAL INPUT

The term *capital* is an elusive concept. A *capital good* is an item produced that can be used to aid in further production. The actual measurement of capital depends very heavily on what is meant by *production*. Moreover, it is clear that, taken to extremes, virtually *any* expenditure can be "capitalized" (for example, a vacation helps a worker become more productive).

The U.S. Department of Commerce defines gross investment as spending by households and businesses on residences, nonresidential plant and equipment, and inventories, plus the net purchase of foreign assets by Americans less the sale of U.S. assets to foreigners. There are several obvious anomalies with this concept as a measure of capital formation. One is the inclusion in the gross investment calculation of spending on residences. One rationale for this practice is the crediting of owner-occupiers with an "imputed income" from their homes. Including this imputed income in national income and production implies that homebuilding should be included in investment.[3] Another anomaly is the ownership criteria. Automobiles and furniture, when purchased by businesses, are counted in investment, but they are not counted when purchased by households or government agencies. Perhaps more significantly, capital purchased by foreigners and installed in the United States is not included in total investment, although capital purchased by Americans and installed overseas is included.[4]

Some of the problems can be addressed by narrowing the definition of investment to gross or net nonresidential fixed investment—that is, spending in the United States by private business on nonresidential plant and equipment. These data *include* capital spending by foreign-owned firms and *exclude* residential and inventory investment. For the balance of this discussion, the term *investment* should be understood to refer to nonresidential fixed investment.

Turning to capital stock data, the *gross capital stock* is a measure of the quantity of capital in service. Gross investment, in constant dollars, less an estimate of the quantity of capital that has reached the end of its productive life and been scrapped, provides the increment to the gross capital stock. A capital good is fully counted in the gross capital stock data until it is retired from service; no account is made of depreciation as the good ages. If all capital was of one type, the real gross capital stock provides an estimate of the number of "units" of capital in service. The real gross capital stock can also be usefully thought of as an estimate of the resource cost of constructing the currently installed stock of capital.

In any event, it is clear that the *ratio* of gross investment to GNP, by itself, reveals nothing about increases in the gross capital stock or its growth rate. Furthermore, constant *levels* of gross investment will eventually result in a declining *rate of growth* of the gross capital stock. Discussions of capital

formation that take gross investment levels or ratios to GNP out of the context of capital stock growth have obvious limitations.

The Commerce Department also calculates (on a straight-line basis for each category of capital) a depreciation series for the capital stock in service. Gross investment less depreciation defines net investment. The *net capital stock* is cumulated net investment. Conceptually, the depreciation series is a rough estimate of the loss of value of the existing capital stock as it ages.[5] The net investment series represents an estimate of the resources devoted to increasing the value of the capital stock, implying that the net capital stock series is a measure of the value of the capital stock. The net capital stock is sometimes referred to as a "wealth measure." Viewed strictly, this is incorrect, but it does capture the flavor of the concept. As in the case of gross investment, the ratio of net investment to GNP by itself tells nothing about the growth of the net capital stock, and a constant level of net investment implies a falling rate of growth of the net capital stock.

None of these measures—gross and net investment or gross and net capital stock—strictly corresponds to the contribution of capital to economic growth.[6] Ideally, an assessment of investment performance requires a measurement of the effect of capital on the potential output of the economy, in both the immediate and the long run.

Investment, either gross or net, does not measure the contribution of capital to potential output; it is simply a measure of spending on capital goods. If the productivity of existing capital is falling, high levels of, or rapid growth in, gross or net investment can be associated with a declining overall contribution of capital to output.

Furthermore, growth in the "official" gross and net capital stocks does not necessarily suggest corresponding growth in the productivity of capital. As mentioned earlier, the gross capital stock series can be viewed as a measure of the resources used to construct the existing capital stock, and the net series as an estimate of the resources needed to purchase the existing capital stock. Replacing the items in the gross and net capital stock with items of equal resource cost or value, but of different productivities, will not alter these series but will change the productivity of the aggregate capital stock. In other words, the productivity of the capital stock will change with changes in the composition of the capital stock, as well as with changes in the aggregate amount spent to acquire capital.

A simple example will illustrate this point. One automobile costs very roughly about the same as five good personal computers. Does the contribution of five personal computers to a car rental company's output equal that of one car? Does the contribution of one car to a bank's output equal that of five personal computers?

These compositional issues will not arise if the mix of gross investment was unchanged; the growth of both the underlying gross capital stock and the net capital stock will match the growth of the underlying productivity of the capital stock.[7] This unchanged mix assumption is clearly false, however, in the real world, as the above example regarding personal computers shows; the paragraph would not have made any sense fifteen years ago! Given this problem, is it possible to directly measure the productivity of the aggregate capital stock?

Economists have developed techniques that, in principle, can be used to infer the actual productivity of capital. Dale Jorgenson, now of Harvard University, was the pioneer in this "user cost" approach. Jorgenson's insight was that in market equilibrium the earnings from a physical investment—which are, of course, directly related to the productivity of the capital good purchased—must equal the cost of the funds used to acquire the asset, adjusted for tax factors. In principle, we can directly measure the cost of funds and can observe the details of the tax code, implying that we can infer the productivity of capital.

Many economists have devoted much ingenuity to making ever-more refined estimates of these productivities, or "user costs," or "capital input." Indeed, the Bureau of Labor Statistics (BLS) publishes estimates of the input of capital (which it calls "capital services") in a number of sectors.

However, as a practical matter, one must be somewhat skeptical of these user cost calculations. The basic theory is simple and elegant, but the practical implementation is very difficult. The analyst must be able to observe current and expected levels of financing costs, tax variables, and prices. Even more fundamentally, the analyst must make some assumption about the basic nature of the technology utilizing the capital good, including an assumed time profile of its physical productivity. Furthermore, the final calculated user cost strictly applies to newly purchased capital. In principle, market forces will compel the reinstallation of existing capital into modes that will yield the current "optimal" user cost. Such switches could be costly and time-consuming and may not be justified if user costs are volatile.[8] Thus, the effect of changes in user costs on the productivity of existing capital is quite difficult to infer.

Given the problems involved in measuring user costs, many analysts are willing to settle for the standard capital stock measures as adequate proxies for the capital input. However, there has been a recent reemphasis on the inadequacy of the gross and net capital stock measures in reflecting capital mix changes. Over the past generation the U.S. investment mix has shifted markedly to shorter-lived capital goods. Such a shift will depress the growth of the gross and net capital stocks. (Both depreciation and scrappage rates will increase.) Some contend, however, that such a shift will, at least temporarily, *increase* the productivity of the capital stock. (All else equal, a shorter-lived piece of capital must have a higher average annual productivity

than an equal-valued but longer-lived capital good.) This argument suggests that the net and gross capital stock series may have understated the growth of the aggregate capital input in recent years. If one mistrusts formal user cost measures, this poses a severe problem in actually observing movements in the capital input.

Some analysts further suggest that in the presence of severe shifts to short-lived investment, gross investment may provide a better rough first approximation to changes in the actual productivity of capital than does net investment or the net and gross capital stocks. The logic is that under such circumstances all three of the latter measures will grow more slowly than before—the reverse of the movement in the true capital input—while the gross investment series will, at least, not move perversely with a shift in the investment mix.[9]

The mix problem is valid in a formal sense but appears to overstate actual U.S. developments. First, the year-to-year changes in the age mix of U.S. investment have not been *rapid* (although cumulated over time, they have been severe). Age-mix shifts are important only if we are concerned with very short-term *changes* in the capital input, or if we are concerned with long-term developments in the *level* of the capital input. (If the composition of the capital stock is radically different between two points in time and we do not observe the actual productivity of capital, then comparison of the productivities of the two stocks becomes quite tenuous.)

Second, there is good reason to believe that the actual annual productivity of short-term capital installed in the United States has not been much higher than the long-term capital it has replaced. As a general rule, the price of short-lived capital goods has declined relative to the price of long-lived capital goods. In full market equilibrium, other things equal, a decline in the relative price of a capital good means that its relative productivity has also declined. Therefore, the replacement of long-lived by short-lived capital has not likely increased the productivity of capital as much as age considerations alone would suggest.[10]

A recent study that I coauthored addressed the general issue of measuring proxies for the productivity of capital.[11] We found that the gross capital stock and the net capital stock have moved in tandem and that their movements have paralleled those of the aggregate BLS capital service measure. Gross investment has moved in a markedly different manner. Regression analysis showed gross investment to be substantially inferior to the capital stock measures or the BLS capital service series in explaining movements in U.S. nonfarm business output. Thus, one can reasonably argue that, at an aggregate level, growth in the easily observed gross or net capital stock series is a decent proxy for growth in the productivity of capital.

## EMPIRICAL ESTIMATES OF CAPITAL FORMATION

In this section, I discuss major trends in the growth of gross and net capital and the aggregate capital service series. I infer, without restating, that changes in gross or net capital are good guides to changes in the productivity of capital. Although I discuss movements in the capital/labor and capital/ output ratios, the reader should be aware that long-term changes in these ratios may be misleading because of changes in the mix of the capital stock.[12]

*The Aggregate Capital Stock*

The highest level of aggregation that this discussion will address is the nonfarm business sector. In 1989, real nonfarm nonhousing business output of $3,196 billion accounted for 78 percent of real GNP. The residual was produced on farms, by governments, and in households. There are significant problems in measuring output in these latter sectors and in inferring the contribution of capital.

Figure 1 illustrates the long-run movement in the real net and gross capital stocks and in the BLS capital input measure for the entire nonfarm business sector. Figure 2 illustrates the corresponding capital/labor ratios, and Figure 3 shows the capital/output ratios. Figure 1 shows the slowdown in capital stock growth over the last generation. The gross capital stock grew at an average rate of 3.5 percent in the 1960s; its growth actually strengthened in the 1970s but then fell in the 1980s (see Table 1). The BLS capital service series has moved in a comparable fashion, while net capital stock growth has seen a much sharper decline over the last generation.

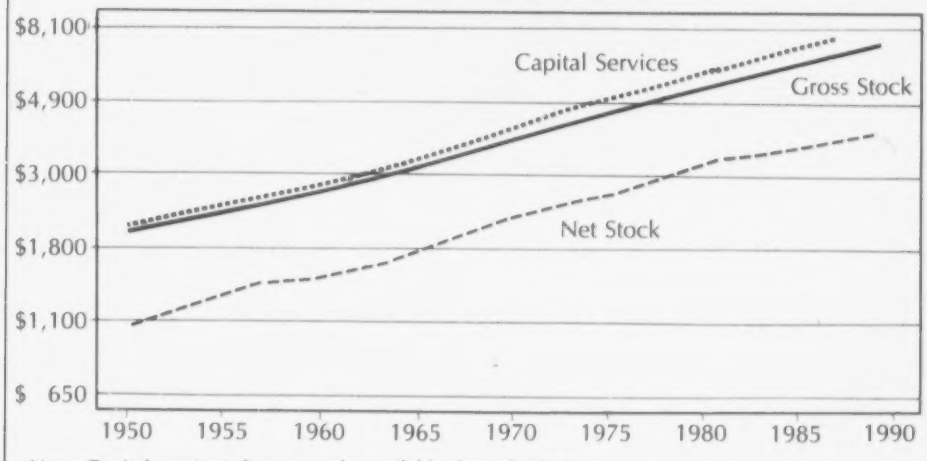
Figure 1 suggests the importance of putting raw investment data into context. True, gross investment as a share of GNP has been at a high level in recent years. The lessened growth of the capital stock series, however, shows that the investment share was too low to keep gross capital growing at the pace of the 1970s or even to maintain the reduced growth in the net stock of the 1970s.[13] (Alternately, given the realized investment/GNP ratio, higher levels of GNP would have been necessary to reach higher capital stock growth rates.)

Gross investment less scrappage—the retirement of capital that has reached the end of its service life—yields the increment to the gross capital stock. Gross investment less depreciation yields the increment to the net capital stock. Both scrappage and depreciation rates increased markedly in the 1980s as the capital stock became more concentrated in shorter-lived types.

Given the actual scrappage and depreciation rates of the 1980s, the gross investment/GNP ratio would have had to average more than 13 percent in the 1984 – 1989 period to have restored gross and capital stock growth to

Figure 1

**Real Net and Gross Capital Stock and Capital Services (billions of 1982 dollars)**




*Note:* Capital services data are only available through 1987.

the trend of the 1960s; the ratio would have had to average more than 14 percent to have returned net stock growth to the pace of the 1960s. Alternately, given realized gross investment levels, lower depreciation rates would have resulted in more rapid growth of net capital. Lower rates of depreciation would have come about if the gross investment mix of the 1980s had been more heavily weighted to long-lived capital. However, given the actual aggregate investment levels of the 1980s, even a complete concentration of the investment mix in the longest-lived types would likely have been insufficient to restore net capital stock growth to its 1960s pace.

Figure 2 illustrates movements in the ratio of gross capital, net capital, and the BLS capital services measure to hours worked. In the late 1970s, the start of the slowdown in the growth of the capital measures, coupled with an acceleration in hours worked, resulted in a flattening of the capital/labor ratio. The slowdown in employment in the years around 1980 led to some increases in these ratios, but these gains ended with the employment growth of the expansion.

The lack of improvement in the capital/labor ratio over the last generation, which troubles many, has often been linked to the slowdown in the growth of labor productivity. All else equal, more rapid growth in the capital/labor ratio will spur labor productivity growth. However, it is generally accepted that many other factors affect labor productivity, most importantly, the growth of technical progress. Undoubtedly, though, the slowdown in the capital/labor ratio has worked to reduce the growth of labor productivity and put downward pressure on real wages.[14]

Figure 2

**Real Capital Stock/Labor and Capital Services/Labor Ratios (constant 1982 dollars per hour)**

*Note:* Capital services data are only available through 1987.

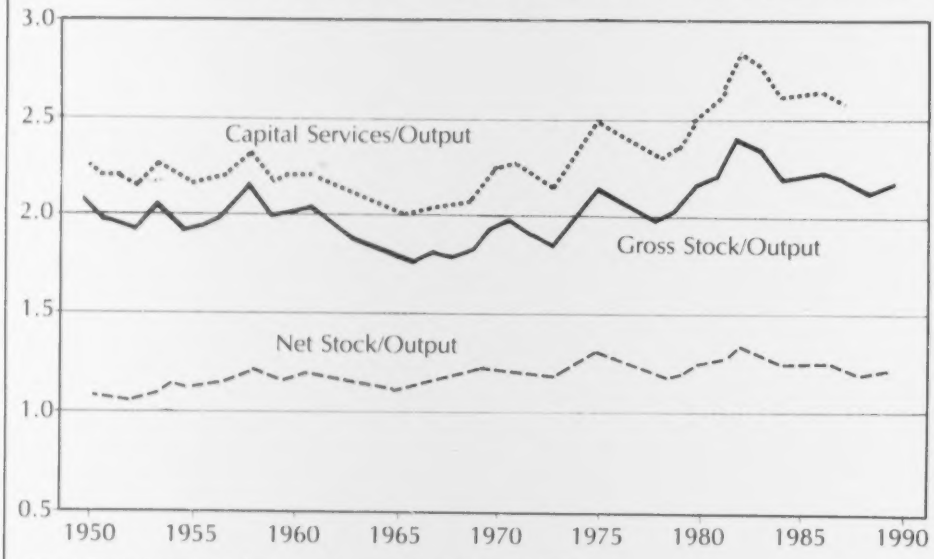
Finally, Figure 3 illustrates moves in the ratio of capital to output. Moves in this ratio depend fundamentally on movements in the capital/labor ratio and on the growth of technical progress. A slowdown in the growth of the capital/labor ratio will reduce the capital/output ratio (in effect, labor is directly "responsible" for producing a larger share of output), as will an acceleration in the growth of technical progress (something other than capital is "responsible" for the growth of output). Over the last generation, the capital/labor ratio has levelled off, and the rate of technical progress appears to have slowed. The two effects have roughly offset each other, leaving the capital/output ratio about unchanged.

*Industry Details*

The slowdown in capital formation has not been uniform. Tables 1 and 2 show that the slowdown in capital stock growth was most evident in the goods-producing sectors of manufacturing, mining, and construction, with a number of industries seeing outright declines in net and gross capital in the 1980s. In contrast, capital stock growth accelerated in trade, finance, and service industries. In general, employment tended to fall in the goods-producing sector over the last generation while rising in the service-producing sector. In manufacturing, the slippage in employment offset the weakness in capital stock growth, and the net and gross capital labor ratios in manufacturing industries continued to grow during the 1980s—in the durable goods sector significantly more rapidly than in the nondurable goods sector. (See Tables 3 and 4 for trends in gross and net capital/labor ratios.) In the service-producing sector, rapid growth in employment was outstripped by growth in the gross and net capital stock, and capital/labor ratios rose rapidly in a number of areas, especially trade and finance.

Figure 3

**Real Capital Stock/Output and Capital Services/Output Ratios**




*Note:* Capital services data are only available through 1987.

The transportation sector appears as an anomaly; its gross and net capital stocks and capital/labor ratios fell in the 1980s. This resulted in part from the common practice of leasing transportation equipment. The capital stock data credits such equipment to the owner of record (which is often a financial firm) rather than to the user. Thus, it seems plausible that there is some downward distortion in the capital stock data in the transportation sector and upward distortion in finance.

Table 5 shows growth in the Federal Reserve Board's capacity series for manufacturing industries. In general, capacity continued to grow in the 1980s at rates at least comparable to those of the 1970s in many manufacturing industries, despite the weakening of capital stock growth in the later period. This is not as paradoxical as it might seem. Capacity, as defined by the Federal Reserve Board, is not an alternative measure of capital; rather, it is an index of the maximum efficient output an industry can produce. Capacity can grow either because an industry's allotments of capital and labor have increased or because there are increases in the industry's efficiency (technological progress). The continued growth of industrial capacity and output in the 1980s at rates comparable to earlier decades, despite slowdowns in the growth of manufacturing capital and employment, illustrates that capital inputs are not necessarily the only factors behind growth.[15] Not surprisingly, analysts have attributed the sharp improvement in labor productivity in manufacturing in the 1980s to technological improvements.[16]

Table 1

## Growth in the Gross Capital Stock (average percent change in 1982 dollars)

| | 1950–59 | 1960–69 | 1970–79 | 1980–89 | 1989 Level (billions of 1982 dollars) |
|---|---|---|---|---|---|
| **Total** | **2.8** | **3.5** | **3.8** | **3.5** | **6883.0** |
| Mining | 5.6 | 2.6 | 2.3 | 1.6 | 484.7 |
| Construction | 4.3 | 3.4 | 4.5 | -1.6 | 93.9 |
| Manufacturing | 3.5 | 4.0 | 4.3 | 2.2 | 1483.1 |
| Durables | 4.6 | 4.7 | 3.8 | 2.6 | 836.1 |
| Primary Metals | 3.9 | 4.3 | 2.6 | -0.1 | 154.4 |
| Fabricated Metals | 5.5 | 5.3 | 4.4 | 2.4 | 92.4 |
| Nonelectric Machinery | 5.2 | 4.4 | 4.4 | 4.5 | 151.9 |
| Electric Equipment | 5,0 | 7.2 | 5.7 | 6.8 | 140.6 |
| Motor Vehicles | 6.6 | 4.3 | 3.5 | 1.3 | 88.2 |
| Other Transportation Equipment | 5.3 | 6.2 | 3.5 | 4.6 | 67.0 |
| Instruments | 5.7 | 7.2 | 5.4 | 5.7 | 36.1 |
| Nondurables | 2.5 | 3.3 | 3.6 | 1.7 | 647.1 |
| Food | 0.4 | 1.6 | 2.6 | 1.7 | 129.1 |
| Textiles | -0.7 | 0.8 | 2.4 | -0.7 | 35.1 |
| Apparel | 0.4 | 6.4 | 4.9 | -0.3 | 11.6 |
| Paper | 4.6 | 4.3 | 3.5 | 3.0 | 99.4 |
| Chemicals | 4.4 | 4.9 | 4.6 | 1.0 | 169.3 |
| Petroleum | 4.6 | 2.2 | 3.2 | 1.8 | 87.6 |
| Rubber and Plastic | 4.7 | 7.0 | 5.5 | 1.1 | 42.7 |
| Transportation | -0.9 | -0.2 | 0.8 | -0.3 | 529.4 |
| Communication | 6.1 | 6.5 | 6.3 | 4.5 | 572.4 |
| Electric and Gas Utilities | 4.3 | 3.5 | 3.7 | 2.2 | 824.1 |
| Wholesale Trade | 4.5 | 7.7 | 6.7 | 8.0 | 346.1 |
| Retail Trade | 2.0 | 4.4 | 4.7 | 5.0 | 446.7 |
| Finance, Insurance, and Real Estate | 4.0 | 5.3 | 4.6 | 6.3 | 1393.9 |
| Services | 5.3 | 6.5 | 5.4 | 5.6 | 676.2 |

Table 2

## Growth in the Net Capital Stock (average percent change in 1982 dollars)

| | 1950–59 | 1960–69 | 1970–79 | 1980–89 | 1989 Level (billions of 1982 dollars) |
|---|---|---|---|---|---|
| **Total** | **3.8** | **4.3** | **3.6** | **3.0** | **3830.4** |
| Mining | 6.4 | 1.7 | 2.6 | -0.3 | 213.6 |
| Construction | 2.5 | 4.7 | 4.8 | -2.6 | 49.5 |
| Manufacturing | 3.5 | 4.7 | 3.8 | 1.4 | 780.0 |
| Durables | 5.3 | 5.1 | 3.2 | 1.8 | 442.3 |
| Primary Metals | 5.8 | 4.4 | 1.6 | -2.1 | 70.3 |
| Fabricated Metals | 5.6 | 5.5 | 4.0 | 1.3 | 49.5 |
| Nonelectric Machinery | 4.2 | 4.7 | 4.5 | 3.5 | 84.1 |
| Electric Equipment | 4.8 | 8.3 | 4.6 | 6.9 | 84.9 |
| Motor Vehicles | 6.6 | 4.7 | 2.8 | -0.4 | 43.7 |
| Other Transportation Equipment | 8.3 | 6.7 | 2.2 | 4.5 | 37.9 |
| Instruments | 6.0 | 8.3 | 4.5 | 5.3 | 20.5 |
| Nondurables | 1.9 | 4.2 | 3.4 | 0.9 | 337.7 |
| Food | -0.3 | 2.5 | 2.7 | 1.0 | 67.6 |
| Textiles | -2.2 | 3.6 | 1.6 | -1.7 | 16.6 |
| Apparel | 0.9 | 8.0 | 4.1 | -1.7 | 5.9 |
| Paper | 4.0 | 4.6 | 3.2 | 2.7 | 55.0 |
| Chemicals | 3.4 | 5.8 | 4.2 | -0.4 | 85.6 |
| Petroleum | 4.3 | 1.8 | 3.3 | 0.4 | 43.5 |
| Rubber and Plastic | 4.3 | 8.4 | 4.6 | 0.0 | 21.8 |
| Transportation | -0.6 | 0.3 | 1.4 | -0.7 | 254.6 |
| Communication | 6.5 | 6.7 | 6.0 | 3.5 | 323.8 |
| Electric and Gas Utilities | 6.0 | 3.5 | 3.3 | 1.5 | 455.9 |
| Wholesale Trade | 4.9 | 8.7 | 6.2 | 8.1 | 212.8 |
| Retail Trade | 3.6 | 5.9 | 4.5 | 4.9 | 270.8 |
| Finance, Insurance, and Real Estate | 6.2 | 6.6 | 3.9 | 6.2 | 855.2 |
| Services | 7.6 | 7.5 | 4.4 | 5.6 | 396.7 |

Table 3

**Growth in the Gross Capital/Labor Ratio (average percent change)**

| | 1950–59 | 1960–69 | 1970–79 | 1980–89 |
|---|---|---|---|---|
| **Total** | **1.2** | **1.3** | **2.0** | **1.8** |
| Mining | 7.5 | 3.6 | -1.9 | 5.3 |
| Construction | 1.4 | 0.9 | 2.6 | -2.8 |
| Manufacturing | 2.0 | 2.1 | 3.7 | 3.0 |
| Durables | 2.4 | 2.3 | 3.6 | 3.7 |
| Primary Metals | 4.0 | 2.9 | 3.1 | 5.2 |
| Fabricated Metals | 3.6 | 2.1 | 4.4 | 4.2 |
| Nonelectric Machinery | 3.6 | 1.0 | 2.4 | 6.5 |
| Electric Equipment | 0.5 | 3.3 | 5.2 | 7.2 |
| Motor Vehicles | 8.5 | 1.3 | 2.9 | 3.6 |
| Other Transportation Equipment | -1.4 | 4.4 | 5.1 | 3.4 |
| Instruments | 1.1 | 3.8 | 3.3 | 5.0 |
| Nondurables | 1.8 | 2.0 | 4.0 | 2.0 |
| Food | 1.0 | 1.3 | 2.9 | 2.2 |
| Textiles | 2.0 | 0.1 | 3.9 | 1.4 |
| Apparel | 0.6 | 4.7 | 5.8 | 1.5 |
| Paper | 2.3 | 2.1 | 3.7 | 3.1 |
| Chemicals | 1.7 | 2.1 | 3.8 | 1.5 |
| Petroleum | 4.9 | 3.4 | 2.2 | 4.9 |
| Rubber and Plastic | 2.3 | 2.1 | 3.4 | 0.4 |
| Transportation | -0.1 | -0.8 | 0.4 | -1.5 |
| Communication | 4.8 | 3.9 | 4.1 | 5.1 |
| Electric and Gas Utilities | 3.3 | 2.3 | 2.0 | 0.9 |
| Wholesale Trade | 2.9 | 5.2 | 4.1 | 6.1 |
| Retail Trade | 0.5 | 2.0 | 2.4 | 3.2 |
| Finance, Insurance, and Real Estate | 0.5 | 2.0 | 1.1 | 3.6 |
| Services | 3.0 | 2.7 | 1.5 | 1.2 |

Table 4

**Growth in the Net Capital/Labor Ratio (average percent change)**

| | 1950–59 | 1960–69 | 1970–79 | 1980–89 |
|---|---|---|---|---|
| **Total** | **2.2** | **1.9** | **1.8** | **1.4** |
| Mining | 8.3 | 2.6 | -1.6 | 3.1 |
| Construction | -0.4 | 2.2 | 2.8 | -3.8 |
| Manufacturing | 2.0 | 2.7 | 3.3 | 2.1 |
| Durables | 3.0 | 2.7 | 3.0 | 2.8 |
| Primary Metals | 5.9 | 3.0 | 2.2 | 3.1 |
| Fabricated Metals | 3.6 | 2.2 | 4.0 | 3.1 |
| Nonelectric Machinery | 2.6 | 1.3 | 2.5 | 5.4 |
| Electric Equipment | 0.2 | 4.3 | 4.1 | 7.3 |
| Motor Vehicles | 8.4 | 1.7 | 2.2 | 2.7 |
| Other Transportation Equipment | 1.0 | 4.8 | 3.7 | 3.2 |
| Instruments | 1.4 | 4.8 | 2.4 | 4.6 |
| Nondurables | 1.3 | 2.8 | 3.7 | 1.1 |
| Food | 0.3 | 2.1 | 3.1 | 1.6 |
| Textiles | 0.5 | 2.7 | 3.0 | 0.4 |
| Apparel | 1.1 | 6.3 | 5.1 | 0.1 |
| Paper | 1.7 | 2.3 | 3.4 | 2.7 |
| Chemicals | 0.9 | 2.9 | 3.4 | 0.0 |
| Petroleum | 4.5 | 3.0 | 2.3 | 3.5 |
| Rubber and Plastic | 1.9 | 3.4 | 2.5 | -0.7 |
| Transportation | 0.2 | -0.3 | 1.0 | -1.9 |
| Communication | 5.1 | 4.1 | 3.8 | 4.1 |
| Electric and Gas Utilities | 4.9 | 2.4 | 1.6 | 0.2 |
| Wholesale Trade | 3.6 | 6.2 | 3.6 | 6.2 |
| Retail Trade | 2.1 | 3.6 | 2.2 | 3.1 |
| Finance, Insurance, and Real Estate | 2.6 | 3.2 | 0.5 | 3.4 |
| Services | 5.2 | 3.6 | 0.6 | 1.3 |

*Capital Type*

Tables 6 and 7 present data on the growth of gross and net capital, respectively, by type of plant and equipment. During the 1950s and 1960s, growth was rapid in items such as industrial structures and equipment. In the 1970s, though, there was an accelerated shift in the capital mix toward short-lived information-processing equipment, such as computers, and a marked slowdown in the growth of long-lived industrial equipment and structures. This process continued and accelerated even more in the 1980s. The growth of industrial equipment and structures was quite slow, while the computer surge continued unabated. The only long-lived capital category that showed substantial growth in the last decade was commercial structures (stores and office buildings), whose contribution to industrial output is meager.

Table 5

**Growth in Manufacturing Capacity (average percent change)**

| | 1950–59 | 1960–69 | 1970–79 | 1980–89 |
|---|---|---|---|---|
| **Total** | **4.4** | **5.5** | **3.3** | **3.2** |
| Durables | NA | NA | 3.3 | 3.8 |
| Primary Metals | NA | NA | 0.5 | -1.6 |
| Fabricated Metals | 3.6 | 4.2 | 2.0 | 0.5 |
| Nonelectric Machinery | 4.9 | 6.1 | 5.9 | -10.4 |
| Electric Equipment | 8.0 | 10.3 | 5.3 | 5.4 |
| Motor Vehicles | 2.9 | 4.7 | 4.1 | 1.4 |
| Other Transportation Equipment | 5.3 | 3.0 | 1.3 | 3.5 |
| Instruments | 7.5 | 9.8 | 6.9 | 5.6 |
| Nondurables | NA | NA | 3.4 | 2.2 |
| Food | 3.0 | 3.3 | 3.2 | 2.3 |
| Textiles | 1.5 | 6.5 | 2.0 | 0.7 |
| Apparel | NA | NA | 1.6 | 1.3 |
| Paper | 4.4 | 6.1 | 2.5 | 2.0 |
| Chemicals | 10.8 | 11.7 | 5.0 | 1.7 |
| Petroleum | 5.7 | 2.7 | 4.1 | -1.0 |
| Rubber and Plastic | 7.8 | 12.4 | 7.1 | 4.9 |
| Utilities | NA | NA | 4.2 | 1.1 |

Table 6

**Growth in the Gross Capital Stock by Type (annual percent change in 1982 dollars)**

| | 1950–59 | 1960–69 | 1970–79 | 1980–89 | 1989 Level (billions of 1982 dollars) |
|---|---|---|---|---|---|
| **Total** | **2.8** | **3.5** | **3.8** | **3.5** | **6883.0** |
| Equipment | 5.0 | 4.6 | 5.2 | 4.4 | 3622.5 |
| Information Processing | 10.2 | 7.9 | 9.4 | 12.3 | 1139.0 |
| Industrial | 5.5 | 4.2 | 4.0 | 2.1 | 1196.0 |
| Motor Vehicles | 4.6 | 6.7 | 6.6 | 2.8 | 387.7 |
| Aircraft | 10.7 | 14.3 | 5.6 | 4.5 | 152.8 |
| Structures | 1.7 | 2.8 | 2.7 | 2.5 | 3260.4 |
| Industrial | 2.1 | 4.6 | 2.4 | 1.3 | 439.7 |
| Commercial | 2.1 | 5.1 | 4.6 | 4.6 | 942.2 |
| Public Utility | 2.7 | 2.8 | 3.5 | 2.0 | 774.9 |
| Petroleum | 6.9 | 2.0 | 1.1 | 2.6 | 329.7 |

Once again, it is conceivable (although not ascertainable from the aggregate output data) that this shift to short-term equipment *may* have provided a short-term boost to output. Even if this argument is valid, the situation will be reversed in the long run. In the long run, all else equal, citizens of a country with a shorter-lived capital stock will consume less than citizens of a country with a longer-lived stock.[17] Thus, the shift to short-lived capital would have negative consequences for long-run U.S. growth, unless saving rates increase or it can be associated with more rapid technological change.

*Industry Capital by Type: The Shift to Computers*

Table 8 shows the 1970s and 1980s trends in gross capital by industry, comparing growth in the total stock and growth in information-processing equipment. Table 9 repeats the exercise for net capital. The most striking point about these tables is the uniformity of the surge in information-processing equipment. Most notably, the data suggest that manufacturers have substituted computers for basic industrial machinery and structures.

Table 7

**Growth in the Net Capital Stock by Type (annual percent change in 1982 dollars)**

| | 1950–59 | 1960–69 | 1970–79 | 1980–89 | 1989 Level (billions of 1982 dollars) |
|---|---|---|---|---|---|
| **Total** | **3.8** | **4.3** | **3.6** | **3.0** | **3830.4** |
| Equipment | 4.7 | 4.9 | 5.0 | 4.1 | 2012.8 |
| Information Processing | 8.9 | 8.2 | 9.5 | 12.2 | 673.0 |
| Industrial | 5.2 | 4.2 | 3.7 | 1.4 | 637.3 |
| Motor Vehicles | 3.9 | 7.1 | 6.1 | 3.0 | 237.4 |
| Aircraft | 10.6 | 15.4 | 3.1 | 5.1 | 87.1 |
| Structures | 3.3 | 3.8 | 2.5 | 1.9 | 1817.6 |
| Industrial | 3.8 | 5.5 | 1.2 | 0.2 | 224.5 |
| Commercial | 4.5 | 6.8 | 4.2 | 4.3 | 586.1 |
| Public Utility | 4.5 | 3.3 | 3.3 | 1.0 | 437.3 |
| Petroleum | 7.5 | 0.3 | 1.7 | 1.1 | 144.1 |

Looking at manufacturing more closely, can it be said that the increased acquisition of short-lived, "high-tech" capital has enhanced labor productivity? Stephen Roach, who explored the linkage between high-tech capital and productivity, found that an increased endowment of high-tech capital per worker in manufacturing industries may have contributed to accelerated productivity growth, but he found little evidence of such an effect in other sectors.[18]

There may be a partial explanation of Roach's results. As noted earlier, the declining cost of high-tech capital could suggest declines in its productivity relative to other capital goods. This would be consistent with new high-tech capital being used in relatively low-valued applications. This process is likely more advanced in the computer-intensive service sector. The *low cost* of the capital justifies service companies purchasing additional high-tech capital. However, these cost savings need not add up to impressive productivity gains on an industry or an aggregate level.[19] Manufacturing may be in an earlier stage of transition to more computer-intensive production, and the initial cost savings could be higher.

Table 8

## Growth of Gross Capital Stock and Information-Processing Equipment by Industry (1982 dollars; percent per year)

| | 1970–1979 | | 1980–1989 | | Information-Processing Share of Total Capital Stock– | |
|---|---|---|---|---|---|---|
| | Total | Info. Processing | Total | Info. Processing | 1979 | 1989 |
| **Total** | **3.8** | **9.4** | **3.5** | **12.3** | **6.8** | **15.9** |
| Mining | 2.3 | 13.8 | 1.6 | -3.1 | 0.1 | 0.1 |
| Construction | 4.5 | 9.5 | -1.6 | 17.8 | 0.9 | 5.0 |
| Manufacturing | 4.3 | 13.8 | 2.2 | 11.9 | 4.2 | 10.2 |
| Durables | 3.8 | 12.3 | 2.6 | 16.1 | 3.5 | 11.7 |
| Primary Metals | 2.6 | 16.0 | -0.1 | 6.2 | 3.4 | 6.1 |
| Fabricated Metals | 4.4 | 3.3 | 2.4 | 17.5 | 0.6 | 2.4 |
| Nonelectric Machinery | 4.4 | 15.3 | 4.5 | 18.1 | 6.1 | 20.2 |
| Electric Equipment | 5.7 | 8.7 | 6.8 | 18.2 | 8.5 | 23.1 |
| Motor Vehicles | 3.5 | 16.6 | 1.3 | 18.7 | 0.8 | 3.6 |
| Other Transportation Equipment | 3.5 | 8.3 | 4.6 | 17.5 | 3.5 | 11.1 |
| Instruments | 5.4 | 9.7 | 5.7 | 24.8 | 2.3 | 12.0 |
| Nondurables | 3.6 | 15.3 | 1.7 | 7.1 | 5.0 | 8.3 |
| Food | 2.6 | 11.2 | 1.7 | 6.9 | 4.0 | 6.5 |
| Textiles | 2.4 | 3.5 | -0.7 | 6.4 | 0.7 | 1.3 |
| Apparel | 4.9 | 12.4 | -0.3 | 9.3 | 2.0 | 4.8 |
| Paper | 3.5 | 18.0 | 3.0 | 18.6 | 0.7 | 2.9 |
| Chemicals | 4.6 | 17.2 | 1.0 | 4.6 | 11.9 | 16.7 |
| Petroleum | 3.2 | 14.1 | 1.8 | 9.4 | 2.9 | 5.8 |
| Rubber and Plastic | 5.5 | 14.4 | 1.1 | 15.6 | 0.9 | 3.2 |
| Transportation | 0.8 | 2.5 | -0.3 | 10.0 | 0.6 | 1.5 |
| Communication | 6.3 | 8.8 | 4.5 | 6.4 | 47.0 | 56.1 |
| Electric and Gas Utilities | 3.7 | 12.2 | 2.2 | 14.0 | 1.5 | 4.4 |
| Wholesale Trade | 6.7 | 20.5 | 8.0 | 22.8 | 8.4 | 30.1 |
| Retail Trade | 4.7 | 15.1 | 5.0 | 16.2 | 1.7 | 4.8 |
| Finance, Insurance, and Real Estate | 4.6 | 7.3 | 6.3 | 19.2 | 8.2 | 25.5 |
| Services | 5.4 | 8.3 | 5.6 | 13.5 | 9.8 | 20.2 |

Table 9

## Growth of Net Capital Stock and Information-Processing Equipment by Industry (1982 dollars; percent per year)

| | 1970–1979 | | 1980–1989 | | Information-Processing Share of Total Capital Stock | |
|---|---|---|---|---|---|---|
| | Total | Info. Processing | Total | Info. Processing | 1979 | 1989 |
| **Total** | **3.6** | **9.5** | **3.0** | **12.2** | **7.0** | **17.0** |
| Mining | 2.6 | 17.5 | -0.3 | -7.2 | 0.1 | 0.1 |
| Construction | 4.8 | 15.9 | -2.6 | 15.8 | 1.1 | 5.5 |
| Manufacturing | 3.8 | 15.2 | 1.4 | 10.4 | 4.6 | 10.5 |
| Durables | 3.2 | 13.7 | 1.8 | 14.8 | 3.8 | 12.4 |
| Primary Metals | 1.6 | 19.4 | -2.1 | 2.7 | 4.1 | 6.4 |
| Fabricated Metals | 4.0 | 6.9 | 1.3 | 17.3 | 0.6 | 2.6 |
| Nonelectric Machinery | 4.5 | 17.1 | 3.5 | 16.4 | 6.4 | 19.8 |
| Electric Equipment | 4.6 | 8.3 | 6.9 | 18.3 | 8.6 | 22.9 |
| Motor Vehicles | 2.8 | 19.4 | 0.4 | 17.1 | 1.0 | 3.9 |
| Other Transportation Equipment | 2.2 | 8.5 | 4.5 | 17.0 | 3.7 | 11.2 |
| Instruments | 4.5 | 12.5 | 5.3 | 24.8 | 2.3 | 12.3 |
| Nondurables | 3.4 | 16.8 | 0.9 | 5.0 | 5.4 | 8.0 |
| Food | 2.7 | 10.6 | 1.0 | 5.4 | 4.1 | 6.1 |
| Textiles | 1.6 | 3.8 | -1.7 | 7.6 | 0.6 | 1.4 |
| Apparel | 4.1 | 11.4 | -1.7 | 8.4 | 2.0 | 5.2 |
| Paper | 3.2 | 19.9 | 2.7 | 17.8 | 0.8 | 3.0 |
| Chemicals | 4.2 | 19.2 | -0.4 | 12.0 | 12.9 | 16.3 |
| Petroleum | 3.3 | 17.5 | 0.4 | 6.7 | 3.2 | 5.7 |
| Rubber and Plastic | 4.6 | 15.8 | 0.0 | 14.6 | 0.9 | 3.3 |
| Transportation | 1.4 | 1.4 | -0.7 | 12.8 | 0.6 | 2.0 |
| Communication | 6.0 | 8.4 | 3.5 | 5.4 | 45.6 | 54.5 |
| Electric and Gas Utilities | 3.3 | 13.0 | 1.5 | 14.1 | 1.6 | 4.9 |
| Wholesale Trade | 6.2 | 21.9 | 8.1 | 22.2 | 8.8 | 29.2 |
| Retail Trade | 4.5 | 15.8 | 4.9 | 16.2 | 1.7 | 4.7 |
| Finance, Insurance, and Real Estate | 3.9 | 8.1 | 6.2 | 20.4 | 7.6 | 26.5 |
| Services | 4.4 | 8.0 | 5.6 | 14.6 | 9.3 | 20.9 |

## CONCLUSION

Despite historically strong levels of gross investment in the 1980s, the recorded growth of the gross and net capital stocks has continued to slow, in part because of a shift in investment to short-lived items. Slow growth in the gross and net capital stocks need not entail a slowing in the contribution of capital to national output, at least in the short run, *if* there is a redistribution of the capital stock mix to high-productivity types. Although the shift in the mix of the U.S. capital stock to shorter-lived types could be indicative of a shift to higher productivity, explicit measures of the aggregate capital input and other evidence fail to record any beneficial impact from the shift.

The slowdown in capital stock growth has been most striking in the manufacturing sector. Although capital is only one factor affecting the growth in industrial capacity, one may be concerned about the implications of these trends for the long-term growth of manufacturing output. This concern is heightened if one believes that there is a direct connection between capital stock growth and technological improvement. Increased manufacturing output is probably the best way to eliminate the U.S. external deficit, and an accelerated growth in the industrial capital base would appear to be a prerequisite for this to occur.[20]

Appendix

## THE RELATIONSHIP OF THE GROSS AND NET CAPITAL STOCKS AND THE PRODUCTIVITY OF CAPITAL

In a situation of heterogeneous capital, where the output contribution from a capital good depends on both its type and its age, the relationship between the aggregate productivity of capital and the standard gross and net capital stocks is complex. Nonetheless, under certain circumstances the net and gross stocks will bear a fixed proportional relationship to the true aggregate productivity, meaning that their growth will be a valid proxy for the trend in productivity.

First, algebraic formulas for the gross and net stocks and for the aggregate productivity will be derived. We begin by assuming that there are N different types of capital. Let $I(i,j)$ equal gross investment in year $i$ in type $j$ capital. Let $T(j)$ equal the service life of type $j$ capital; after $T(j)$ years the capital is no longer productive. According to a straight-line assumption, the annual depreciation on type $j$ capital purchased in year $i$ is equal to $I(i,j)/T(j)$. Finally, let $\delta(j,k)$ be the productivity per dollar of gross investment in type $j$ capital in year $k$ of service, where $k$ runs from 1 to $T(j)$.

These assumptions are sufficient to derive expressions for the gross and net stock series and for aggregate productivity. The gross stock is simply the sum of all capital in place that has not reached the end of its service life. The amount of type $j$ capital in service is equal to all investment in type $j$ goods for the last $T(j)$ years, or $\sum_{i=1}^{T(j)} I(-i,j)$. The total gross capital stock sums all these types, or

$$(1)\quad \sum_{j=1}^{N} \sum_{i=1}^{T(j)} I(-i,j) \qquad \text{(Gross capital stock).}$$

The net capital stock deducts from the gross stock the cumulated depreciation on each item. For each year of service, a dollar investment in type $j$ capital records $1/T(j)$ dollars in depreciation. Therefore, the cumulated depreciation on the investment in type $j$ capital made $i$ years ago equals $[i * I(-i,j)]/T(j)$. The cumulated depreciation on all type $j$ capital in service equals $\sum_{i=1}^{T(j)} [i * I(-i,j)]/T(j)$. The net stock of type $j$ capital subtracts this depreciation from the gross stock. It then equals $\sum_{i=1}^{T(j)} \{[T(j)-i] * I(-i,j)\}/T(j)$. The total net capital stock sums all these

types, or

$$(2)\ \sum_{j=1}^{N}\ \sum_{i=1}^{T(j)} \left\{ [T(j) - i] * I(-i,j) \right\} / T(j) \qquad \text{(Net capital stock).}$$

The productivity of the investment in type $j$ capital made $i$ years ago equals $\delta(j,i) * I(-i,j)$. The productivity of all type $j$ capital equals $\sum_{i=1}^{T(j)} \delta(j,i) * I(-i,j)$. The productivity of the aggregate capital stock is found by summing the productivity of all types:

$$(3)\ \sum_{j=1}^{N}\ \sum_{i=1}^{T(j)} \delta(j,i) * I(-i,j) \qquad \text{(Aggregate productivity of capital).}$$

As a general rule, there is no simple relationship between these expressions, which depend in a complex way on the exact distribution of investment by type and year and the precise time profile of productivity by capital type. However, these expressions can be used to get a sense of some of the distortions that can be potentially caused by using the gross and net stocks as proxies for the aggregate productivity of capital. For instance, suppose the investment mix swings toward types that have very high initial productivities but short service lives. Inspection of the formulas will show that expression (3)—the true aggregate productivity—will increase, while expressions (1) and (2) will fall. (Depreciation will increase as investment swings toward shorter-lived goods, reducing the net capital stock. The gross capital stock will also be reduced, as a larger proportion of investment in any one year will be removed from service.) Some have argued that this is the situation the United States has experienced in recent years. However, in the text I argue that the shift to short-lived investment has not necessarily implied a shift to high-productivity goods, suggesting no short-term acceleration in aggregate capital productivity.

There is an important special case in which the three measures bear a fixed relationship to each other. This occurs when the investment mix is fixed and aggregate investment grows at a constant rate. In other words, first assume that $I(i,j) = \gamma(j)I(i)$, where $\sum_{j=1}^{N} \gamma(j) = 1$, and $I(i)$ is aggregate gross investment in year $i$. The second assumption is that $I(i)=(1+g)^i I(0)$, where $I(0)$ is the aggregate gross investment level in some reference year. Under these assumptions, it can be shown that the aggregate gross capital stock will equal $\sum_{j=1}^{N} \gamma(j) \sum_{i=1}^{T(j)} (1+g)^i I(0)$, the aggregate net capital stock will equal

$\sum_{j=1}^{N} \gamma(j) \sum_{i=1}^{T(j)} \{[T(j)-i]/T(j)\} * (1+g)^i I(0)$, and the aggregate productivity of capital will equal $\sum_{j=1}^{N} \gamma(j) \sum_{i=1}^{T(j)} \delta(j,i) * (1+g)^i I(0)$. All three of these expressions will grow at the rate of g percent per year.

Of course, under these special circumstances it will also be true that both gross and net investment will grow at a rate of g percent. However, if investment should show some annual fluctuations, in both the aggregate amount and its composition, there will still be some underlying stability and common trends in the productivity and capital stock series.

## NOTES

1. See, for example, John A. Tatom, "U.S. Investment in the 1980s: The Real Story," Federal Reserve Bank of St. Louis *Review*, March-April 1989, pp. 3-15.

2. See, for example, M. Akbar Akhtar, "Adjustment of U.S. External Balances," Federal Reserve Bank of New York *1988 Annual Report*, 1989.

3. These imputed incomes are also added to consumption, so they do not affect saving. Why should homeowners be credited with their imputed incomes? One reason is to prevent the artificial distortion of the national income data from the conversion of residences to and from owner-occupancy. No one would argue that rents are not legitimately part of national income. Failing to impute rents to owner-occupiers would mean that a paper transaction—for instance, the conversion of an apartment building to condominium status—could reduce national income.

4. This treatment results from the equality of gross national product (GNP) and gross national income. The income from capital accrues to its owner, not to the country in which the capital is installed. Attributing capital's income to its owner means that investment should be measured by ownership as well. If the output measure were gross domestic product (GDP)—the output produced within the borders of the United States—foreign investment in the United States would add to total U.S. investment.

5. The estimate is rough because there is no correction for interest rates or the time profile of returns from capital.

6. Gross investment is, of course, a component of GNP. All else equal, an increase in investment implies an increase in GNP. The problem is that if the economy is operating at full potential, an increase in gross investment will be offset by declines in other spending categories. Moreover, investment's stimulus in the short run does not yield its long-run impact on output.

7. See the appendix for a demonstration.

8. Putting it concretely, a 1967 user cost calculation may have persuaded a garment manufacturer to convert existing machinery to specialize in Nehru jacket manufacture. In retrospect, such a switchover would not have been wise if it took more than a few months or if it was costly to reverse.

9. For an advocacy of this view, see Frank de Leeuw, "Interpreting Investment-to-Output Ratios," in Allan H. Meltzer, ed., *Unit Roots, Investment Measures and Other Essays*, Carnegie-Rochester Conference Series on Public Policy, vol. 32 (1990), pp. 83-120. For critiques, see A. Steven Englander and Charles Steindel, "Evaluating Recent Trends in Capital Formation," Federal Reserve Bank of New York *Quarterly Review* 14 (Autumn 1989), pp. 7-19; and Stephen D. Oliner, "The Formation of Private Business Capital: Trends, Recent Developments, and Measurement Issues," *Federal Reserve Bulletin* 75 (December 1989), pp. 771-783.

10. An obvious rejoinder to this argument involves computers. Everyone knows that computer prices have fallen sharply and computing power has risen dramatically. Is it not then true that the increasing importance of short-lived computers in the capital stock implies increased productivity? Not necessarily. First, the argument in the text involves relative, not absolute, productivities. Instead of computers, U.S. industry may have installed more productive long-lived capital. Second, computing power is not the same as economic productivity. Increased computing power—and lower costs—have

caused computers to be more heavily used in lower-valued applications and contributed to increased idleness for the machines.

11. Englander and Steindel, "Evaluating Recent Trends in Capital Formation."

12. Changes in the productivity of labor stemming from changes in the skill mix of labor may also distort the meaning of changes in capital/labor ratios. Labor input is traditionally measured by hours worked. Changes in the skill mix of the labor force can change the productivity of a given quantity of worker hours.

13. The match between aggregate gross investment and the BLS measure is weak, because the capital service measure is more sensitive to the capital stock mix than either the aggregate gross or net stocks. Still, holding constant the investment mix, an increase in gross investment would also imply an increase in the capital service measure.

14. Jorgenson, Gollop, and Fraumeni, using highly disaggregated data, found that a slowdown in capital formation can account for much of the slowdown in productivity growth in the 1970s. However, there is a substantial further portion of the productivity slowdown that they cannot readily explain by changes in the growth and distribution of inputs. See Dale W. Jorgenson, Frank M. Gollop, and Barbara M. Fraumeni, *Productivity and U.S. Economic Growth* (Cambridge, Mass.: Harvard University Press, 1987).

15. For a discussion of the capacity concept, see Richard D. Raddock, "Revised Federal Reserve Rates of Capacity Utilization," *Federal Reserve Bulletin* 71 (October 1985), pp. 754-766. For the connection between capacity growth and capital stock growth, see R. Spence Hilton, "Capacity Constraints and the Prospects for External Adjustment and Economic Growth: 1989-90," Federal Reserve Bank of New York *Quarterly Review* 14 (Winter-Spring 1989), pp. 52-68.

16. A rejoinder to this downplaying of capital's role is the argument that manufacturers have been replacing old, inefficient capital with new, advanced technology. Thus, the endowment of "efficient" capital per worker has increased, leading to accelerated productivity growth. The problem with this notion is that it implicitly assumes that the productivity and efficiency of capital are not captured in its valuation. The discussion in the first part of the paper concedes that this may be the case, but evidence that this effect is important is slim on an economy-wide basis. It is a bit hard to believe that an argument that fails for the economy as a whole would apply to the large manufacturing sector, since that would imply that new capital installed in the nonmanufacturing sector is less efficient than that which it replaces.

17. The nation endowed with shorter-lived capital will devote a larger share of its resources to replacing worn-out capital. Thus, to achieve the same rate of overall output growth, the first country must save more and consume less. If the first country attempts to consume at the same rate as the second, it will eventually wear out its capital stock, which will eliminate its ability to produce output for its citizens to consume.

18. Stephen S. Roach, "Pitfalls on the 'New' Assembly Line: Can Services Learn from Manufacturing?" Morgan Stanley and Company, Special Economic Study, June 22, 1989.

19. A quick rejoinder is that the new technology allows for impressive *quality* gains. The author of this article can personally produce a more impressive-looking document than a highly skilled secretary would have produced fifteen years ago. However, unless these quality gains pass market tests, they do not add to measured output or produc-

tivity. The author doubts strongly that his inflation-adjusted salary matches that in 1975 of a similarly employed person plus a skilled typist.

20. E. Gerald Corrigan stated: "We in the United States simply do not have the industrial capacity or stock in labor markets needed. . . to eliminate the trade deficit." See E. Gerald Corrigan, "Strengthening International Policy Coordination," Federal Reserve Bank of New York *Quarterly Review* 13 (Autumn 1988), pp. 1-5. M. Akbar Akhtar wrote: "Eliminating the international deficit, therefore, will be possible only if there is a significant shift of resources to the manufacturing sector. . . . manufacturing investment and capital stock will have to increase much more rapidly in the future. . . ." See M. Akbar Akhtar, "Adjustment of U.S. External Balances," Federal Reserve Bank of New York *1988 Annual Report*, 1989.

# Commentary

# Robert Gillingham

Steindel's very interesting and thought-provoking paper addresses an extremely important question: Is the rate of capital formation sufficient? No one has been able to come up with a satisfactory answer, although many people have sorted through the types of data Steindel used in his paper in order to gain an insight into this issue. Perhaps because these insights are so elusive, I confess to a perverse sense of relief that Steindel has not been able to reach definitive conclusions. Although I would certainly like someone to discover the answers, I would feel rather silly if what has been so perplexing were suddenly readily apparent.

In that vein, I think that this paper reconfirms how difficult it is to evaluate investment performance. This is not a criticism. Rather, it is simply a recognition that the information needed to make such an evaluation is not directly observable and that attempts to construct indirect measures have been extremely frustrating. This point is explicit in Steindel's discussion of the difficulty of constructing theoretically consistent measures of capital service input. The complex of assumptions required to estimate either an implicit rent for a capital good—the standard measure of capital service input—or the related required rate of return for a capital investment makes any such measure problematic. Despite this fact, however, at least within accepted economic theory, these are the appropriate measures for assessing the incentives to invest in and use capital.

The purpose of Steindel's paper is to suggest several alternatives to approximate capital input and to assess the adequacy of capital formation. Despite the usefulness of this exercise, it is still problematic, because these proxies will be valuable only to the extent that they mirror the theoretically appropriate measures, which are, of course, unobserved. Since I agree with most of Steindel's paper, I will do two things. First, rather than list areas of agreement, I will focus on the few areas where I have a slightly different way of looking at the problem. Second, I will discuss a few things that are related to, but not within, the scope of the paper.

## SPECIFIC COMMENTS

I have two comments that relate directly to Steindel's paper. First, I do not think the choice between gross and net concepts is as difficult as he suggests. The net capital stock is a measure of the store of capital services

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All views expressed are those of the author and do not necessarily represent the policies or views of the Department of the Treasury.

that *actually* exists. The gross capital stock is a measure of the total store that *would* exist if each of the assets were brand new. I do not see the value of the gross measure except as an intermediate stage in arriving at a net measure. Similarly, I do not view gross investment as particularly informative. It makes a critical difference whether investment is sufficient to increase or decrease the net stock, since the net stock, not gross investment, determines future production capacity.

As I understand it, the interest in gross investment and the gross capital stock arises because the measurement of depreciation is difficult and uncertain. I understand the problem in measuring depreciation, but that is a *practical*, not a *theoretical*, problem. If we cannot measure depreciation, we will not be able to measure either net investment or the net capital stock. However, since the net concepts are relevant for evaluating investment performance, we do not solve the problem by measuring the gross capital stock more accurately.

Steindel relates the choice of net versus gross investment to the recent shift in investment toward short-lived assets. As a result of this shift, gross investment has not seen the deterioration, relative to output, that has been exhibited by net investment. Because short-lived assets depreciate more rapidly, they will be, in equilibrium, more productive than long-lived assets. However, the greater productivity follows from the fact that more of their product is consumed in the form of asset depreciation. Consequently, the higher productivity of short-lived assets is irrelevant. If we focus on the *net* flow of capital services, rather than the *gross* flow, the presumed "benefit" of shifting to short-lived assets disappears. Short-lived assets will have a higher gross marginal product per dollar of asset, but they will not have a higher rate of return. A simple way to see this is to imagine that a technological advance decreases the rate at which short-lived assets depreciate. In equilibrium, both the rental price and the value of the marginal product of these assets will decrease, but this decrease in "productivity" is unambiguously beneficial. The higher gross product is of no value if it must be used to replenish the capital stock.

The preceding line of reasoning would lead me to focus on the net capital stock if I wanted to evaluate production potential, and net investment if I wanted to assess growth prospects. This is, admittedly, an oversimplified view. A more rigorous analysis would require measurement of the more elusive theoretical constructs of capital rents and rates of return as well. In addition, if new technology must be *embodied* in new capital, replacement investment may play a more important role in economic growth than it would if new technology need not be embodied. This possibility drastically increases the complexity of the analysis, however, since the embodied technological change would result in a revaluation of the existing capital stock, which may be difficult to capture.

My second specific comment on Steindel's paper concerns the focus

on *real* investment and the *real* capital stock. This focus and, more specifically, the choice of the base period for measuring real series may have an important effect on the results. Figure 4 contrasts the movements in the ratios of real and nominal investment to corresponding measures of output. While both began the 1980s at roughly the same level, the nominal ratio has deteriorated at a far more rapid pace. The difference, of course, stems from changes in the relative price of investment goods. Steindel mentions the fact that the price of equipment has fallen substantially relative to the price of structures. In fact, the price of equipment fell so rapidly during the 1980s that the combined price index for plant and equipment fell relative to the price of net national output. Although everyone is aware that changes in the price index for computers are an important component of this change in relative prices, the effect of this one index during the 1980s may still come as a surprise.

Figure 5 displays price indexes for three components of the capital stock: structures; office, computing, and accounting (OCA) equipment; and other equipment. As this figure demonstrates, almost all of the drop in the relative price of equipment stemmed from the drop in computer prices. While the price index for OCA equipment dropped at an annual rate of 11.1 percent from 1980 to 1989, the price index for other equipment rose at a 3.8 percent rate, slightly *faster* than the 3.7 percent rate for structures. In 1982, the base period used in the National Income and Product Accounts for calculating real values, the relative price of OCA equipment was more than three times as high as that in 1989. With relative price changes of this magnitude, the choice of the base period can make an important difference.

Figure 4

**Nominal and Real Ratios of Investment in Plant and Equipment to Net National Product (percent)**

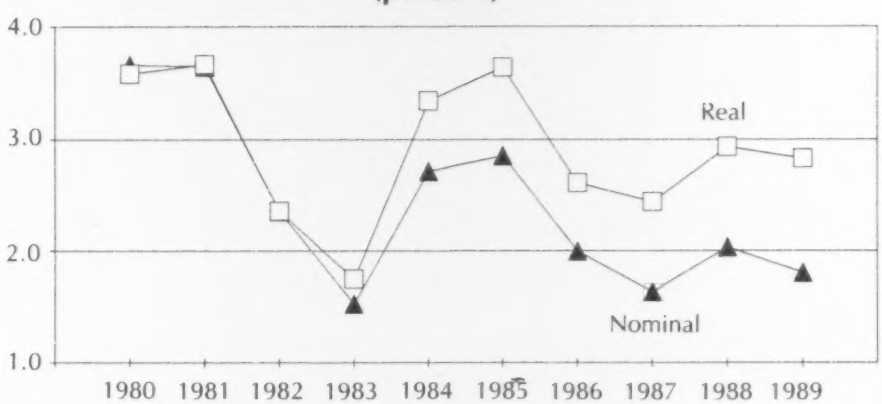
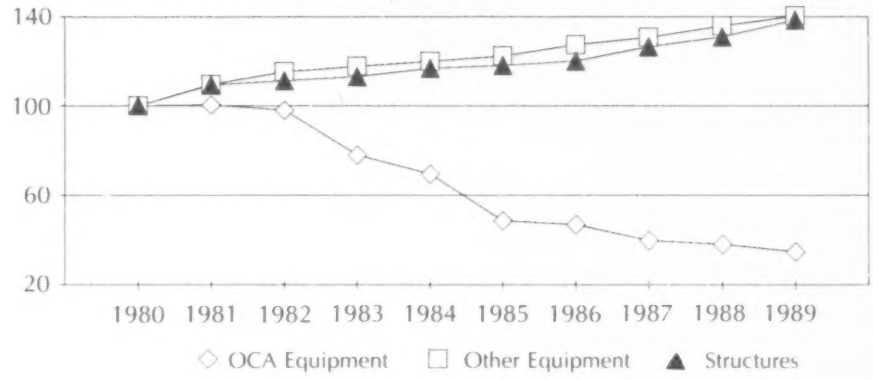


Figure 5

**Indexes of Capital Stock Prices (percent)**




Replacing 1982 with either an earlier or a later year would have a substantial effect on changes in the real ratio of investment to net output. Nonetheless, the nominal ratio is unambiguous and clearly demonstrates a decrease in the proportion of net output committed to increasing production potential. I would not argue that the real ratio is unimportant. Rather, a more sophisticated method for constructing real indexes is necessary to avoid sensitivity in this ratio to arbitrary choices of base period.[1]

## GENERAL COMMENTS

Steindel's paper provides a valuable summary of *how* the capital stock has grown. In the remainder of my comments, I would like to raise some questions about *why* the capital stock has grown as it has. As I mentioned earlier, I believe that net investment is a better indicator of growth potential than gross investment, and net investment has been very low as a proportion of net national product since the early 1980s. Consequently, as Steindel makes clear, the growth rate of the net capital stock has slowed. The difficult question to answer is why. I think that the cost of capital, one of the components of the price of capital services, is a useful vehicle for addressing this question.

In a simple, certain world without taxes, individuals will save and invest as long as the rate of return on their investments exceeds the price they demand for waiting, that is, their "pure rate of time discount." The rate of saving and investment will be "correct," and welfare will be maximized. But the real world is, unfortunately, not that simple or certain, and it is surely not without taxes. The problem is to respond to the complexities in an optimal fashion. The "cost of capital" or, alternatively, the "social rate of return" to investment, wraps the complexities into a theoretical construct in a man-

ner that simplifies at least our understanding of the problem, even if it does not easily solve the practical problem of measuring growth incentives.

The cost of capital measures the gross—in this case, gross of things like taxes, rather than depreciation—rate of return that an investment must yield in order to pay the ultimate investor the net return required to elicit participation in the investment project. In the simplest of worlds, the gross return equals the net return, which in turn equals the pure rate of time discount, and the capital stock will grow at its optimal rate. In a world with taxes and uncertainty, the gross return will exceed the net return, the expected net return will exceed the pure rate of time discount, and the capital stock will grow more slowly. Consequently, it is possible for an investment project to have a high *social* rate of return—a dollar invested may yield *society* $1.15 tomorrow—but a low *private* rate of return—yielding the *private investor* the certainty equivalent of only $1.01.

The important, and basic, question is whether anything can be done to reduce the wedge between the social and private rates of return that will improve the growth in the capital stock and give us enough back in additional future consumption to warrant whatever reduction in current consumption is required. For instance, if it can be demonstrated that substituting one type of tax for another yields a more valuable *consumption* path, the system can be improved.

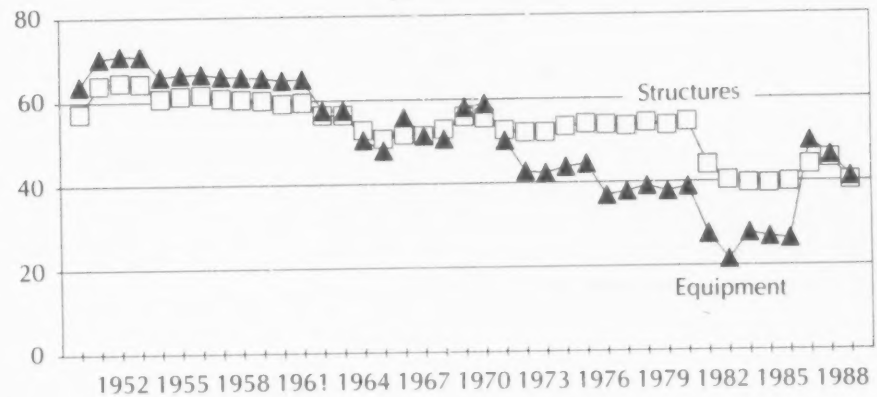
As these examples illustrate, we often look to the tax system as the primary source of the wedge between the social and private rates of return on investment. At least until recently, however, the federal tax wedge on investment—and especially investment in equipment—has trended down. Figure 6 displays estimates of the effective federal tax rate for equipment and structures for the period 1950 to 1988, combining the effects of both corporate and individual taxes. These estimates are calculated for unleveraged, hypothetical investments yielding a constant, real, after-tax rate of return of 4 percent to the ultimate investor.[2] A downward trend is evident in Figure 6, although it has been at least temporarily reversed by the Tax Reform Act of 1986.[3]

There is evidence that economic growth opportunities could be improved by changes in the tax system. For example, I coauthored a study that suggests that a reduction in the capital gains tax rate would improve investment incentives at the same time that it increased tax revenues—a win-win situation.[4] In addition, many analysts are concerned about the double taxation of dividends, and the Department of the Treasury is currently conducting a comprehensive study of this issue.

We certainly should not ignore the possibilities for tax reforms that would enhance the prospects for economic growth. Despite the traditional focus on tax policy, however, many other factors affecting investment incentives deserve attention. These include, but are not limited to: inflation;

Figure 6

**Effective Federal Tax Rates on Investment in Equipment and Structures, 1950–1988 (percent)**




uncertainty about future inflation; uncertainty about the future returns to investment; transactions costs, such as the cost of issuing debt or raising equity; and regulatory costs. A recent contribution by John Shoven to this symposium series is an example of an attempt to deal with some of these issues in a rigorous fashion.[5]

John Greenlees and I have also made some rudimentary first steps toward addressing some of these issues.[6] Unfortunately, our work raises more questions than it answers. Among these questions: Why has the rate of return on equity investments been so much higher than the rate of return on, say, government bonds? Is this all a risk premium? Why, if first principles tell us that future profitability should determine investment, do we seem to find that cash flow is a better variable for explaining investment than theoretically more appropriate variables?[7] Is this an indicator of uncertainty? Transactions costs? A failure of the theory? What is the effect of an increasingly open economy? To what extent are saving and investment decoupled, and how has this affected investment behavior?

These questions are exceedingly difficult but, at least in my opinion, extremely important to answer. Steindel's paper makes a valuable contribution to understanding how investment has behaved in recent years. His results unfortunately provide further evidence that investment performance has deteriorated. The obvious conclusion to be drawn from this evidence is that improving the climate for investment and economic growth must be given high priority.

## NOTES

1. As an aside on real versus nominal measures, the relative price change exhibited by OCA equipment raises additional questions. Are computers the only capital good that has experienced rapid technological change? The prices for all other types of equipment increased at annual rates from 2.5 to 4.7 percent. Recognizing the difficulty in measuring equipment prices, I wonder whether the divergence results from measurement problems in either OCA or other categories of equipment.

2. These estimates are based on simulation 1 in Robert Gillingham and John Greenlees, "Historical Trends in the U.S. Cost of Capital," presented at the Eighty-Third Annual Conference on Taxation, sponsored by the National Tax Association, San Francisco, California, November 13, 1990.

3. For a more detailed discussion of the effect of the Tax Reform Act of 1986 on the cost of capital, see Chapter 2 of the 1987 *Economic Report of the President*; Don Fullerton, Yolanda K. Henderson, and James Mackie, "Investment Allocation and Growth Under the Tax Reform Act of 1986," *Compendium of Tax Research 1987*, Office of Tax Analysis, Department of the Treasury; and Robert Gillingham and John Greenlees, "Estimation of the Cost of Capital When Depreciation is Non-geometric," *Proceedings*, Business and Economic Statistics Section of the American Statistical Association, 1987.

4. See Robert Gillingham and John Greenlees, "The Effect of Marginal Tax Rates on Capital Gains Revenue: Another Look at the Evidence," Office of Economic Policy, Department of the Treasury, December 1, 1990.

5. John Shoven, "Alternate Tax Policies to Lower the U.S. Cost of Capital," in *Business Taxes, Capital Costs, and Competitiveness*, American Council for Capital Formation Center for Policy Research, July 1990, pp. 1-23.

6. Gillingham and Greenlees, "Historical Trends in the U.S. Cost of Capital."

7. See, for example, R. Ford and P. Poret, "Business Investment in OECD Economies: Recent Performance and Some Implications for Policy," Working Paper 88, Organization for Economic Co-operation and Development Department of Economics and Statistics, November 1990; and R.W. Kopcke, "The Determinants of Investment Spending," *New England Economic Review*, July/August 1985.

# Barbara N. McLennan

This panel addresses a significant public-policy concern: the relationship of investment trends to U.S. productivity, competitiveness, and economic growth. Steindel presents a valuable analysis of this complex issue and offers interesting insights into some features of the key aggregate variables. Also, his comments on Department of Commerce statistics are both challenging and of interest to us at the department. We are aware of the role we play in providing information to public policy makers and private decision makers, and this is one reason we constantly strive to ensure that our data and analyses are accurate, reliable, and useful.

Steindel makes at least two important points: (1) neither measures of gross investment nor measures of net investment correspond to the contribution of capital to economic growth; and (2) the growth in the "official" gross and net capital stocks does not imply a parallel growth in the productivity of capital. Steindel reaches two disturbing conclusions in his paper: (1) "despite historically strong levels of gross investment in the 1980s, the recorded growth of the gross and net capital stocks has continued to slow. . . "; and (2) this slowdown in capital stock growth has been most pronounced in the manufacturing sector. Finally, he concludes that "increased manufacturing output is probably the best way to eliminate the U.S. external deficit, and an accelerated growth in the industrial capital base would appear to be a prerequisite for this to occur."

Steindel explains the slowdown in the growth of both gross and net capital stocks as a result of a shift in investment to short-lived goods. He notes that there is no evidence that the United States has experienced benefits in productivity as a result of this shift and points out that although capital is only one factor affecting growth, it has historically been a major factor in the growth of manufacturing output because of the relationship of capital investment to technological improvement.

Despite the trend toward investment in shorter-lived investment goods, the average age of manufacturing's net capital stock in 1989 was 7.8 years, up from 7.1 years in 1980. The average levels of the late 1980s were last seen in 1946. This paradox can be explained by the fact that recent investment in manufacturing has been insufficient to offset the continued aging of a tremendous quantity of long-lived capital—primarily goods-producing plant and equipment of key importance to the long-term health of U.S. manufacturing. This tends to support Steindel's suggestion that recent explosive investment in computers, to the extent that it has substituted for more economically productive investment, has not necessarily been healthy for the U.S. economy and U.S. manufacturing.

It is not my intention to discuss further the problems of measuring capital formation; I will leave that task to those more qualified than myself. I

wish to limit my remarks to the question of what contribution (if any) foreign direct investment in the United States makes to the U.S. capital stock. In other words, I will focus on movements in one component of nonresidential fixed investment as defined by Steindel. Let me note at the outset that I have read, and agree with, Steindel's caveats about the use of net or gross investment to measure the contribution of capital to potential output. Nevertheless, the act of investment is a necessary, if not sufficient, condition for capital formation and improvement in the productive capacity of the economy.

My own organization—Trade Information and Analysis, a unit within the International Trade Administration—keeps track of foreign direct investment in the United States in conjunction with both our ongoing assessment of the international competitiveness of U.S. industry and our role in the administration of the Exon-Florio legislation.[1]

This administration strongly favors the free flow of capital across international borders, a long-standing U.S. policy. My comments on the possible effects of recent trends should not be construed as implying any alteration in this basic position. We believe that the free flow of international capital and the reduction of world-wide barriers to trade and investment will result in greater efficiency, productivity, competitiveness, and economic growth for all countries, including the United States.

Steindel's data on recent trends in capital formation in the United States are disturbing with regard to concerns about ensuring the growth in productive capacity and maintaining a competitive edge internationally. He points out that from a peak of 4.3 percent annually in the 1960s, the growth of the net capital stock fell in each succeeding decade and averaged only 3.0 percent in the 1980s. With the exception of information-processing equipment, what was true for the aggregate was true for every category of nonresidential capital as well.

## TRENDS IN FOREIGN DIRECT INVESTMENT

One component of fixed-investment expenditure that accelerated in the 1980s, however, is foreign direct investment in the United States (FDIUS). While we cannot say *a priori*, or even definitively determine by empirical methods, what (if anything) FDIUS has contributed to U.S. capital stock growth, all foreign investment, including portfolio, may potentially contribute to capital formation. Net foreign capital inflow adds to the pool of savings available to finance domestic investment, which in turn may contribute to capital formation. Alternatively, net foreign investment may finance larger government deficits or offset decreases in personal or business saving. It might therefore be useful to examine data on FDIUS to see what contributions it may have made to the U.S. capital stock.

The 1980s, as noted by Steindel, saw an enormous increase in invest-

ment spending. Steindel states that, by his estimate, investment spending on nonresidential plant and equipment grew by 40 percent between 1982 and 1989. He also states that investment spending averaged more than 12 percent of GNP in the late 1980s, which is very high by historical standards.

At the same time that gross investment was increasing, FDIUS was increasing even more rapidly. FDIUS increased by more than $300 billion in the 1980s. At the end of 1980, the book value of foreign investments was $83 billion; by the end of 1989, it had risen to $401 billion. FDIUS grew at an annual average rate of 19 percent from 1980 to 1989, clearly outpacing the growth in both net domestic investment and nonresidential fixed investment in the United States.

Clearly, not all direct investment is ultimately used to increase the stock of plant and equipment. However, it is not possible to separate out those direct investment flows that add directly to the domestic capital stock from total capital inflows. Also, there is no way to determine the disposition of funds received by U.S. residents for the sale of their companies to foreigners. Finally, we cannot ascertain the indirect benefits to the manufacturing sector of investments and subsequent improvement in the service industries.

Table 10

**FDIUS Positions and Capital Inflow by Industry, 1989 (billions of dollars)**

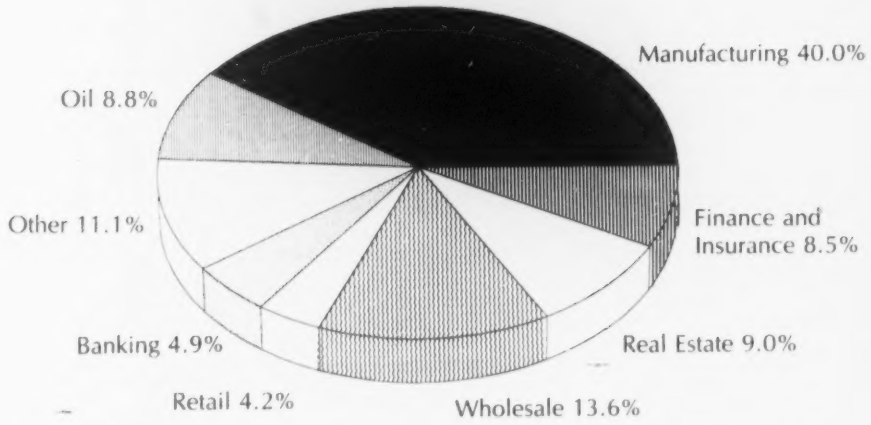
| | Position (end of 1989) | | Capital Inflow | |
|---|---|---|---|---|
| | Amount | Percent | Amount | Percent |
| Oil | 35.1 | 8.8 | 0.6 | 0.8 |
| Manufacturing | 160.2 | 40.0 | 38.9 | 53.8 |
| Wholesale | 54.5 | 13.6 | 4.4 | 6.1 |
| Retail | 16.8 | 4.2 | 1.7 | 2.4 |
| Banking | 19.6 | 4.9 | 2.1 | 2.9 |
| Finance and Insurance | 34.1 | 8.5 | 11.5 | 15.9 |
| Real Estate | 35.9 | 9.0 | 3.9 | 5.4 |
| Other Industries | 44.6 | 11.1 | 9.2 | 12.7 |
| **Total** | **400.8** | **100.0** | **72.2** | **100.0** |

*Note:* Numbers may not add to totals due to rounding.

*Source:* U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business,* August 1990.

Figure 7

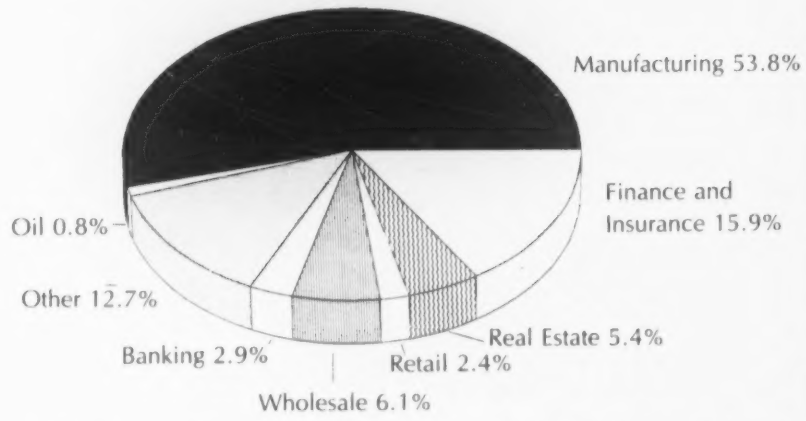
**Foreign Direct Investment Positions in the U.S. by Industry, 1989**




*Source:* U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, August 1990.

Figure 8

**Capital Inflows into the U.S. by Industry, 1989**




*Source:* U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, August 1990.

Gerald H. Anderson and Michael F. Bryan concluded in a recent study that roughly three-fifths of the total foreign capital inflow each year from 1982 to 1989 allowed additional domestic investment and "investment type

consumer spending."[2] This conclusion unfortunately rests on some heroic assumptions and statistical analysis not contained in the paper, so it must be viewed as tentative.

Table 10 and Figures 7 and 8 indicate that the U.S. manufacturing sector has attracted the most FDIUS (40.0 percent), followed by wholesale trade (13.6 percent), and other industries (11.1 percent). This latter category includes mining, agriculture, construction, and services. Of these industries, the service sector received by far the most FDIUS in the 1980s. If we consider only capital inflows (Table 10 and Figure 8), the importance of the manufacturing sector is even greater, accounting for well over one-half of all FDIUS flows in 1989. Wholesale trade was replaced by finance and insurance, while the "other industries" category maintained its third position. Again, new investment in the service industry dominated the "other industries" category.

The growth of FDIUS by industry for the period 1985 – 1989 is summarized in Table 11. The fastest-growing target of FDIUS in recent years has been the service sector, primarily in business services such as equipment leasing and data-processing services and in hotel operations. Foreign investment in this sector is still small, however, in absolute terms. The second fastest-growing magnet for foreign capital, not surprisingly, is the manufacturing sector, where direct investment growth has averaged 28 percent annually.

Can any inferences be drawn from this data concerning the contribution of FDIUS to U.S. capital formation? The short answer is "no," but perhaps the data are suggestive. Clearly, foreign investment in the manufactur-

Table 11

**Growth in FDIUS Positions by Industry, 1985–1989 (average annual percentage rate)**

| | |
|---|---|
| All Industries | 21.4 |
| Petroleum | 5.5 |
| Manufacturing | 28.0 |
| Wholesale Trade | 17.0 |
| Retail Trade | 25.4 |
| Banking, Finance, Insurance | 18.3 |
| Real Estate | 16.6 |
| Other | 39.1 |

*Source:* U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business,* August 1990.

ing, agriculture, mining, and petroleum industries is most likely to directly increase the capital stock. Investment of equal value in the much less capital-intensive retail, wholesale, financial, and business service industries would probably contribute much less to capital formation. However, FDIUS in nonmanufacturing sectors frees up domestic capital to flow to its most efficient use or highest return. As we have seen, FDIUS in the manufacturing sector was, by all measures, exceptionally strong in the 1980s. Thus, it is more likely that foreign direct investment has contributed more directly to the growth of the U.S. capital stock than it would have contributed if it had been directed toward other industries.

Not all FDIUS, even in the manufacturing sector, contributes to capital stock growth. Much of it will be used to purchase existing assets. Nevertheless, even the purchase by foreigners of existing assets may increase the productivity of the existing capital stock, to the extent that foreigners utilize their acquisitions more efficiently and effectively than did the previous U.S. owners.

Additional insights relating foreign direct investment to U.S. capital formation can be gleaned from looking at the source countries. The United Kingdom remained the largest direct investor in the United States in 1989, with almost 30 percent of total FDIUS (see Table 12 and Figure 9). Now in

Table 12

**FDIUS Positions and Capital Inflow by Country, 1989 (billions of dollars)**

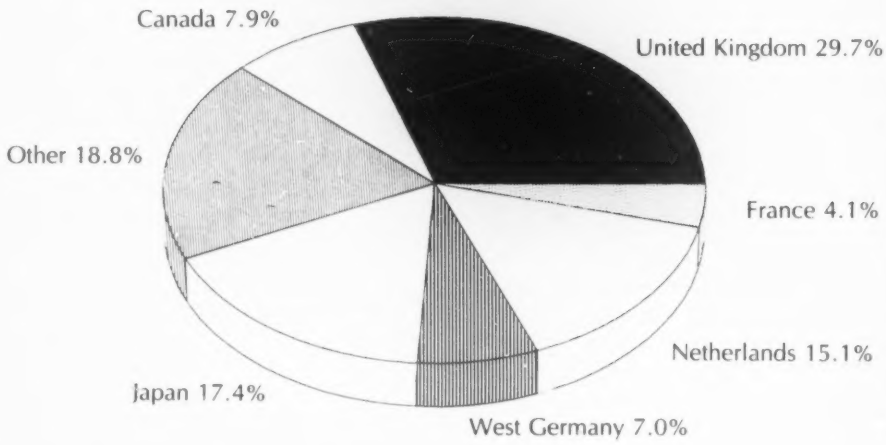
| Country | Position | | Capital Inflow | |
|---|---|---|---|---|
| | Amount | Percent | Amount | Percent |
| Canada | 31.5 | 7.9 | 2.7 | 3.7 |
| United Kingdom | 119.1 | 29.7 | 20.2 | 28.0 |
| France | 16.4 | 4.1 | 5.3 | 7.3 |
| Netherlands | 60.5 | 15.1 | 9.8 | 13.6 |
| West Germany | 28.2 | 7.0 | 4.2 | 5.8 |
| Japan | 69.7 | 17.4 | 17.3 | 24.0 |
| Other | 75.4 | 18.8 | 12.7 | 17.6 |
| **Total** | **400.8** | **100.0** | **72.2** | **100.0** |

*Note:* Numbers may not add to totals due to rounding.

*Source:* U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business,* August 1990.

Figure 9

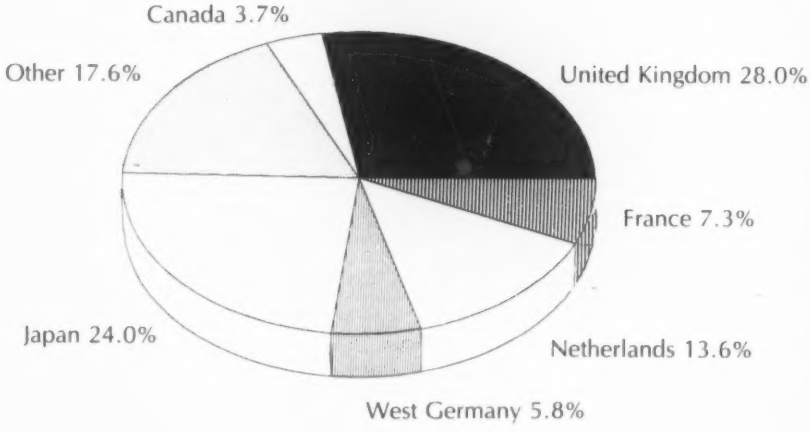
**Foreign Direct Investment Positions in the U.S. by Country, 1989**




*Source:* U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, August 1990.

Figure 10

**Total Capital Inflow into the U.S. by Country, 1989**




*Source:* U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, August 1990.

second place is Japan, which in 1989 provided more than 17 percent of the total. Japan only recently became a major investor in the United States; in 1980, it was the seventh largest source of capital. In recent years, Japan's

investment position in the United States has grown the most rapidly. In 1989, the total capital inflow (portfolio as well as direct) from Japan approached that of Britain (see Figure 10). Not surprisingly, the U.S. manufacturing sector was the major recipient of direct investment from each of the principal countries, although in the case of Japan, real estate ranks a close second.

Although the Bureau of Economic Analysis reports data on direct investment by country to specific industries, knowing the geographical source of the investment does not, by itself, yield many insights as to its contribution to capital formation. What is needed are studies that examine in detail the nature of each individual country's foreign direct investment in the United States. Two studies of this type, both focusing on Japanese direct investment in the United States, were recently published.

## FDIUS FROM JAPAN

The first study, conducted jointly by staffs of the International Trade Administration and the Economics and Statistics Administration,[3] came to the following conclusions relevant to the relationship between FDIUS and capital formation:

- Japan's investment in the U.S. manufacturing sector is relatively small, but growing.

- Japanese investment as measured by employment is highly concentrated in the U.S. automotive, steel, consumer electronics, and computer industries. In terms of industry structure, Japanese companies are present at all stages of production in these industries.

- Japanese investment is greatest in the automotive industry. This sector leads all others in employment (72,000 workers), number of plants (245), number of Japanese companies investing (168), and amount of bilateral trade generated ($35 billion in 1989).

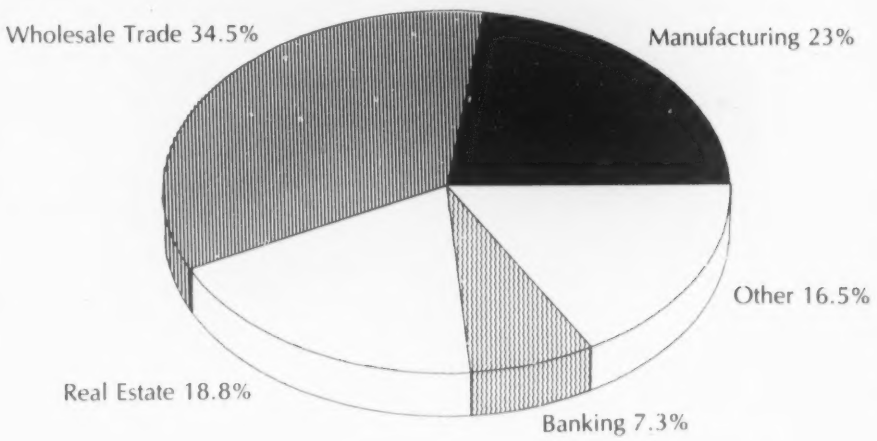
- Access to new technology is an important factor in the acquisition of existing U.S. manufacturing establishments in the advanced electronics sector. In contrast, joint ventures in steel transferred Japanese state-of-the-art technology to the United States.

- U.S. manufacturing affiliates of Japanese firms import far more production inputs (machinery and parts) than do other foreign manufacturing affiliates. The result is a small, but adverse, effect on the U.S. trade deficit with Japan. This pattern may change as Japanese affiliates source more inputs locally and their exports accelerate.

The distribution of Japanese investment in the United States, by industry sector, is shown in Figure 11.

Figure 11

**Japan's Foreign Direct Investment Position in the U.S. Economy by Sector, 1988**




*Source:* Phyllis A. Genther and Donald H. Dalton, *Japanese Direct Investment in U.S. Manufacturing* (Washington, D.C.: U.S. Department of Commerce, June 1990).

Several inferences can be drawn from these conclusions concerning Japanese FDIUS contributions to U.S. capital formation. Japanese investment is highly concentrated in relatively capital-intensive industries, particularly the automotive, steel, and computer industries. In the automotive sector alone, Japanese companies operate 245 plants, which were either newly built or made more productive after being acquired from domestic auto companies. On the other hand, the study concludes that manufacturing affiliates of Japanese firms import far more inputs than do other foreign manufacturing affiliates. This fact suggests that each dollar of capital formation from Japanese direct investment will generate less second-round capital spending than will each dollar of capital formation resulting from the FDIUS of other countries.

The study also demonstrates that the Japanese are prone to invest in companies that have new technology that can be transferred back to Japanese establishments. In this case, FDIUS may enhance the productivity of the Japanese capital stock. By the same token, U.S. direct investment abroad should not be overlooked as a factor contributing to the productivity of our domestic capital stock insofar as it allows us to transfer technology acquired abroad back to the United States.

Some of the conclusions of the Department of Commerce study were reached independently by Bruce Kogut and Sea Jin Chang, who studied Jap-

anese investment in terms of R&D capability and industry structure in 297 industries.[4] These authors concluded that Japanese direct investment in the United States is drawn to industries intensive in R&D expenditures.

## CONCLUSION

Finally, I echo Steindel's point that the elimination of our balance-of-payments deficit will require investment and strong growth in manufacturing industries. So long as the U.S. savings rate continues to remain low, it is likely that FDIUS will be needed to play an important role in this effort. To this end, the United States must continue to promote the freest possible international movement of capital.

The U.S. manufacturing sector is important because, by its sheer size, manufactures trade dominates the U.S. trade and current accounts. Manufactured goods represent 80 percent of both U.S. merchandise exports and imports. The dominant role of manufactures trade in U.S. trade performance is not unique; the great majority of world trade is an exchange of manufactured goods. Manufactured goods are 80 percent of world non-energy exports. Although important, and growing, U.S. trade in business services is still small compared to U.S. merchandise trade, only about one-third as large as merchandise exports, and about one-sixth as large as merchandise imports.

A deterioration in manufactures trade performance was the primary proximate factor for the growing U.S. trade and current account deficits during the 1982 – 1987 period. Any very large improvement in U.S. trade and current accounts will also have to be largely in U.S. manufactured goods trade. In fact, substantial U.S. manufactures trade surpluses may be required to offset oil import deficits and to cover investment income payments to foreign debt holders.

Achieving further major improvement in the U.S. trade balance—assuming no large cuts in imports—will require the United States to sustain high rates of manufactures export growth. This will require not only a favorable dollar exchange rate and a high level of economic activity abroad, but also continued improvement in the quality of U.S. manufactures exports and the development of more technologically advanced products. Moreover, U.S. industrial capacity will have to be sufficient to satisfy the foreign and domestic demand for American products. To meet this challenge, U.S. manufacturing must sustain high rates of capital investment that result in an increasingly modern, productive stock of capital.

## NOTES

1. The so-called Exon-Florio legislation was incorporated as Sec. 5021 of the Omnibus Trade and Competitiveness Act of 1988. It requires that all potential foreign acquisitions of American productive assets be screened and prohibited if the president determines that such acquisition would not be in the interest of national security.

2. Gerald H. Anderson and Michael F. Bryan, "Foreign Capital Inflows: Another Trojan Horse?" *Economic Commentary* (Cleveland: Federal Reserve Bank of Cleveland, November 1, 1990).

3. Phyllis A. Genther and Donald H. Dalton, *Japanese Direct Investment in U.S. Manufacturing* (Washington, D.C.: U.S. Department of Commerce, June 1990).

4. Bruce Kogut and Sea Jin Chang, "Technological Capabilities and Japanese Foreign Direct Investment in the United States," *Review of Economics and Statistics*, forthcoming.

# Joel L. Prakken

Charles Steindel has provided an interesting and thought-provoking look at recent trends in capital formation. His principal conclusions are threefold: (1) the net capital stock is preferable to either the gross capital stock or the flow of gross investment as a measure of capital input; (2) while gross investment ran strongly during the 1980s, slow growth in the net capital stock undermined the expansion of potential output; and (3) a shift in the composition of investment toward relatively short-lived capital assets was responsible for both the comparatively strong performance of gross investment and the comparatively weak performance of the net capital stock. My comments speak to each of these three points in turn.

Regarding the first point, I am accustomed to thinking about the process of economic growth within the context of a traditional neoclassical model of capital accumulation. In such a model, the level of potential output is determined by the existing state of technology, the size of the labor force, and the net capital stock available to workers. From this perspective, the net capital stock is the only barometer of capital input that merits analytical attention. Therefore, while Steindel's discussion of other measures is educational, he does not have to work very hard to convince me (or, I suspect, anyone else in the profession) of the correctness of his position.

As for the second point, Steindel accurately documents the deceleration of the net capital stock during the 1980s.

If I have an analytical bone to pick with Steindel's analysis, it is with the third point: his interpretation of the cause of the deceleration of the net capital stock. His argument goes something like this. For a given flow of gross investment, the larger the share of that investment devoted to replacing capital assets that have depreciated, the less is left over to augment the net stock. Therefore, if in the aggregate the depreciation rate of the capital stock rises, the net capital stock decelerates even though the flow of gross investment may remain high.

During the 1980s, there was a shift in investment toward short-lived assets (that is, assets with a relatively high rate of depreciation). This shift took two forms. First, there was a general movement from spending on structures to spending on equipment. Second, within the total spent on equipment, a rapidly growing share was devoted to office, computing, and accounting (OCA) equipment. Steindel infers that this shift in the composition of investment was like an increase in the depreciation rate of the aggregate capital stock and hence weakened growth in the net capital stock without undermining gross investment.

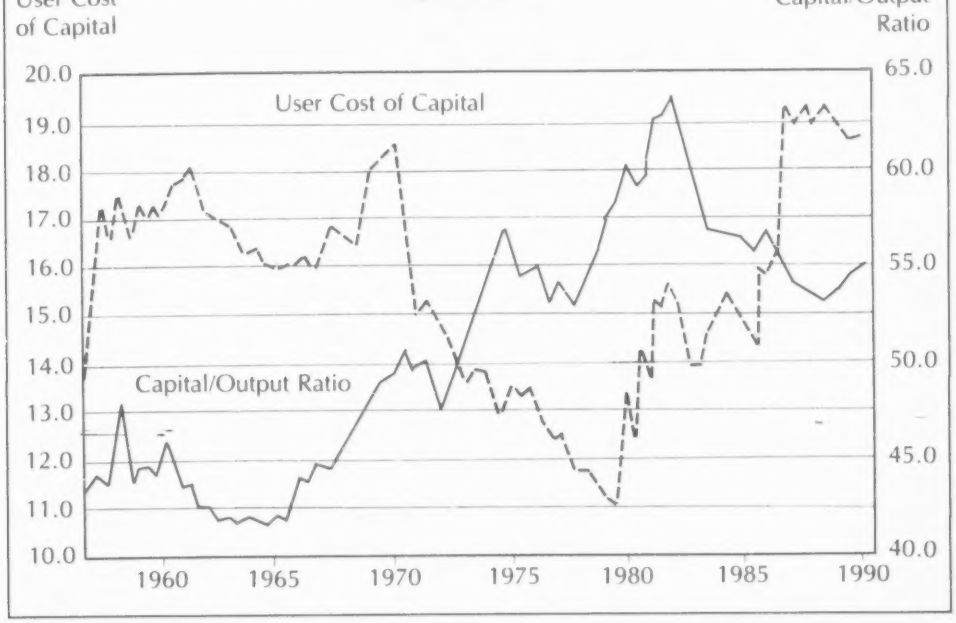
This conclusion leaves unanswered the important question of why the shift in the composition of investment occurred in the first place. The ques-

tion is relevant because its answer has an important bearing on one's view of the ramifications of the shift toward short-lived investments. For example, in my neoclassical growth model, Steindel's result would arise if there was a single type of capital whose depreciation rate increased ex machino. The share of gross investment devoted to depreciation would then rise, as would the user cost of capital. The net capital stock would decline along with potential output. Suppose, however, that there are two types of capital—one that is long-lived (with a low depreciation rate) and another that is short-lived (with a high depreciation rate). Consider next a decline in the user cost of capital for short-lived capital that arises, say, because of a sharp drop in its relative price. The optimal response of firms is to shift investment toward short-lived capital. In equilibrium, the share of gross investment devoted to depreciation would rise. The average cost of capital could rise or fall, but the net capital stock would certainly rise, as would potential output.

In my view, aggregate net capital formation slowed in the 1980s because the cost of capital rose for most classes of capital. Shifts in the composition of aggregate investment occurred because the cost of capital for short-lived investment rose less than the cost of capital for long-lived assets (or in the case of computers, actually fell). The shift in the composition of gross investment was not, as Steindel's analysis suggests, an exogenous event

Figure 12

**User Cost and Capital/Output Ratio for Producers' Durable Equipment Excluding Office, Computing, and Accounting Equipment (percent)**



that retarded net capital formation and growth in output. Instead, the shift reflected an optimizing response of firms to changes in relative price without which the deceleration of potential output associated with an overall rise in the cost of capital would have been even more pronounced.

Figure 12 shows the capital/output ratio for producers' durable equipment (PDE), excluding office, computing, and accounting equipment (OCA), along with the corresponding user cost of capital. Clearly, the user cost rose sharply during the 1980s. There is a bit of a time lag, but by the middle of the decade the capital/output ratio had peaked and was heading downward.

Why did the user cost rise so sharply after 1980? One reason is that the mix of monetary and fiscal policies adopted during the decade produced real rates of interest not witnessed since the Great Depression. However, another important contributing factor was the Tax Reform Act (TRA) of 1986 which, as is well documented elsewhere, significantly raised the user cost of capital associated with any pre-tax real rate of interest. To get a rough idea of the magnitudes involved, I recomputed what the cost of capital for

Figure 13

**User Cost: Producers' Durable Equipment Excluding Office, Computing, and Accounting Equipment Actual and Adjusted to Remove TRA (percent)**

Note: The adjusted cost of capital reflects the capital cost recovery provisions and income tax rates of the Economic Recovery Tax Act (ERTA) of 1981, as modified by the Tax Equity and Fiscal Responsibility Act of 1982 and the Deficit Reduction Act of 1984.

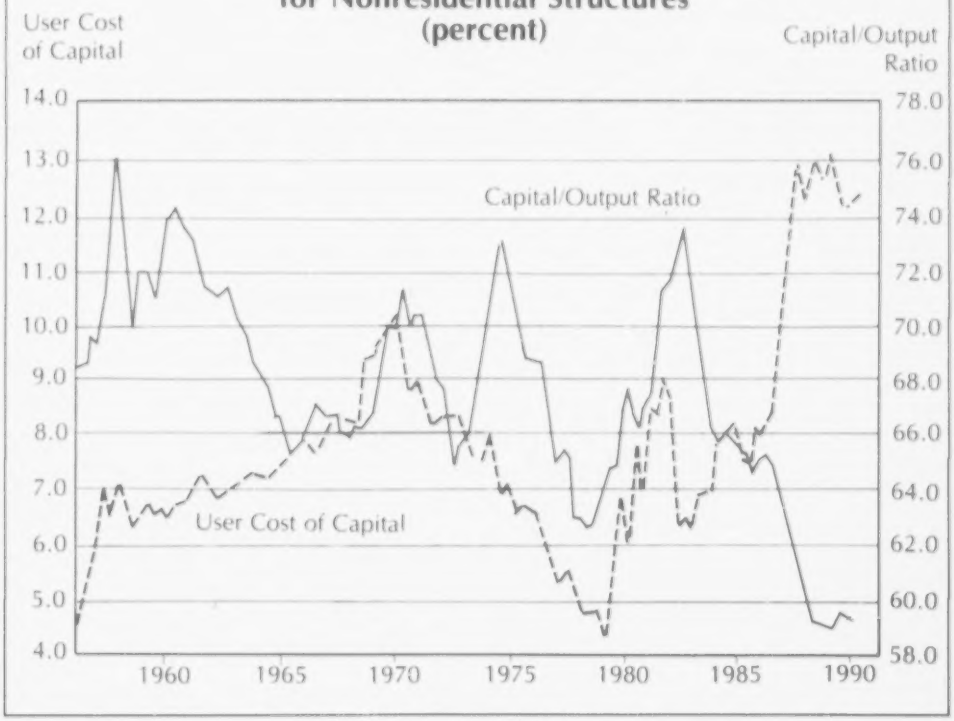
equipment excluding OCA equipment would have been if the Economic Recovery Tax Act (ERTA) of 1981 (as amended by the Tax Equity and Fiscal Responsibility Act of 1982 and the Deficit Reduction Act of 1984)—the tax code in effect immediately prior to the implementation of TRA—had been in effect during the 1955 – 1990 period. This "adjusted" cost of capital is shown in Figure 13, along with the "actual" historical series. Thus, for example, the difference between the "actual" and the "adjusted" series in 1990 reveals how much lower the cost of capital would be today if it were not for the Tax Reform Act. On balance, TRA accounts for fully 40 percent of the increase in user cost that was experienced during the 1980s.

Figure 14 shows the capital/output ratio for nonresidential structures along with the corresponding user cost. It tells much the same story as Figure 12: The cost of structures has been rising sharply, undermining net investment in nonresidential buildings.

Investment in computers has attracted considerable discussion at this symposium—much of which I believe to be off target. Stephen Roach correctly noted that most investment in computers is undertaken in the service industry but, he argues, with apparently little impact on productivity within that key sector of the economy. This supposedly is because firms, seduced

Figure 14

**User Cost and Capital/Output Ratio for Nonresidential Structures (percent)**



by the sex appeal of the little gizmos, spend lots of money on computers and yet have no clear idea of either how to put them to best use or whether they constitute a cost-effective investment. Charls Walker also suggested that computers are nonproductive, claiming that he does not know of a single secretary who lost a job to a personal computer-based word processor.

This thinking is specious for at least three reasons. First, to say that additional computing power has not increased productivity in the service sector implies some knowledge of the counterfactual case, which in fact we have not observed and about which Roach offers no evidence. Second, and here my neoclassical bias rears its rational head, it is difficult for me to believe that so many firms would (indeed, could) consistently invest in any type of capital good if it was not a profit-maximizing strategy. Yes, there is a glitzy aspect to personal computers (PCs), and many a first machine was probably purchased out of curiosity. But a PC is a short-lived asset; most of us are now on our third or fourth generation of equipment. Roach would have us believe not only that we may have erred in acquiring the first machine, but also that we made the same mistake a second time, then a third, and then a fourth. When I was growing up, my parents used to admonish me with the phrase: "Fool me once, shame on you; fool me twice, shame on me." I understand what this means, and I bet most businesses do, too.

Figure 15

**User Cost and Capital/Output Ratio for Office, Computing, and Accounting Equipment (percent)**

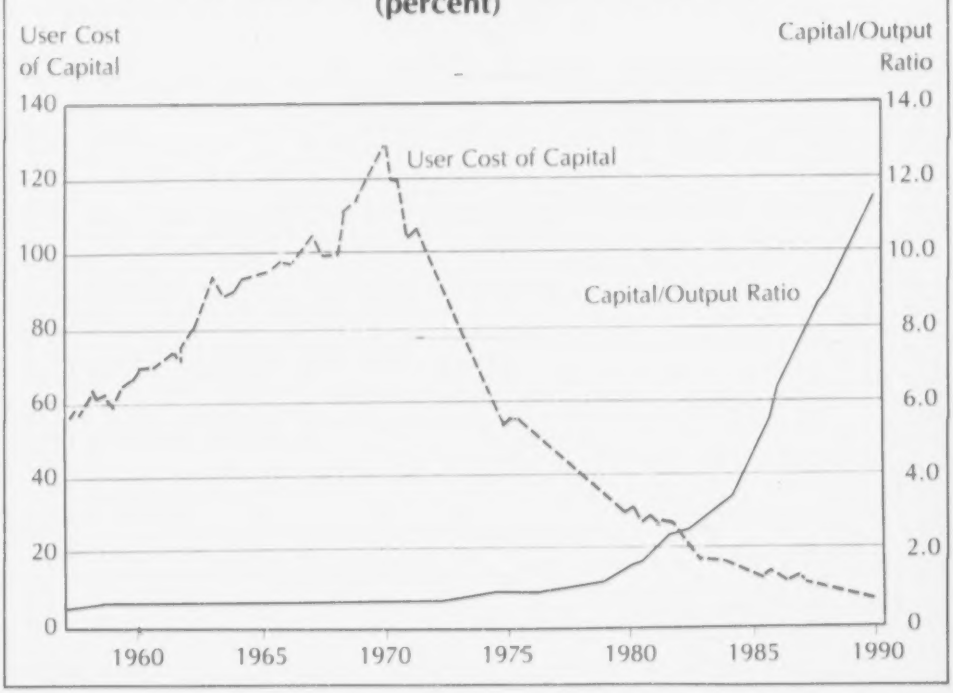
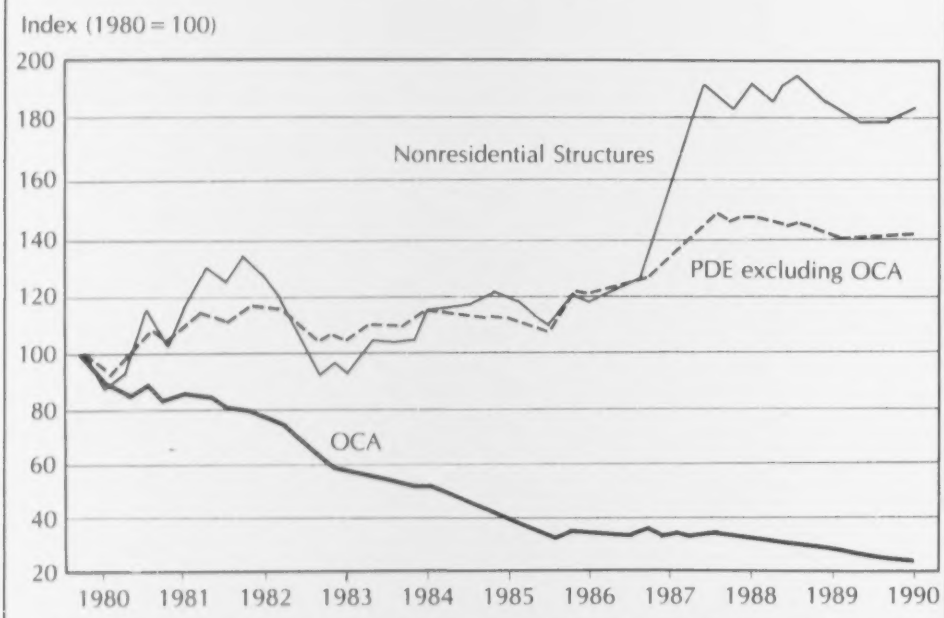


Figure 16

**User Cost of Capital**




*Note:* PDE refers to producers' durable equipment; OCA refers to office, computing, and accounting equipment.

Finally, I cannot say that I personally know a displaced secretary. I do, however, know many secretaries who spend a lot less time on report-writing than they used to and more time on other (new?) activities. And, more to the point, in my firm, which publishes roughly twenty reports a year, we have no secretary. It is cheaper for authors to compose their work directly on the PC.

In my view, the rapid growth in the stock of office, computing, and accounting equipment is largely explicable as an induced response to the plummeting cost of computing. By way of evidence, Figure 15 shows the capital/output ratio for computers along with the corresponding user cost. The rapid rise in the capital/output for OCA equipment mirrors the rapid decline in its user cost—precisely what a neoclassical investment model suggests should happen.

Let me conclude with some evidence that helps explain why the mix of nonresidential investment has been shifting toward short-lived assets. Figure 16 shows the user costs of nonresidential structures (the longest-lived of assets), of producers' durable equipment (PDE) excluding OCA machinery

(the next longest-lived), and of OCA machinery (the shortest-lived). The series have all been normalized to 100 in 1980. The figure reveals graphically that the user cost of structures rose more (in percentage terms) over the decade than did the user cost of equipment other than computers, and that the user cost of equipment excluding computers rose more than did the user cost of computers, which fell sharply. It should not come as a surprise, then, that there was a general shift from spending on buildings to spending on equipment and that a growing share of spending on equipment was devoted to computers. It certainly was not an exogenous event.

# Stephen S. Roach

By the early 1980s, it had become quite clear that the traditional techniques of American production were no longer achieving acceptable results for the overall economy. Productivity was sagging, our foreign trade gap was hemorrhaging, and our standard of living was at risk. The remedy was painfully apparent. What was needed was a wholesale transformation of the structural arrangements between workers and machines—forces that would reshape the very core of our national economic efficiencies.

Restructuring was seen as the way to achieve this transformation. In the lexicon of corporate finance, our working definition of *restructuring* is as follows: unlocking the intrinsic value of corporate assets through a transformation of productive activities in order to remain competitive in a dynamic and increasingly interdependent global economy. Needless to say, the road to restructuring has hardly been smooth. In many respects, it has been very much a process of discovery that has forced corporate America to look well beyond the traditional mindset that guaranteed such stunning success in the first three decades of the postwar era.

Some highlights from the drama of the American restructuring experience are offered below, along with some hints as to what looms ahead.

## STRUCTURAL CHANGE

A recasting of the structure of production may well turn out to be one of the most salient characteristics of U.S. economic performance in the 1980s. This can best be seen by looking at recent trends in the two parameters of our macro production process: shifts in capital formation and changing employment patterns. What emerges are the broad outlines of structural change—a standard for evaluating the productivity potential of any economy.

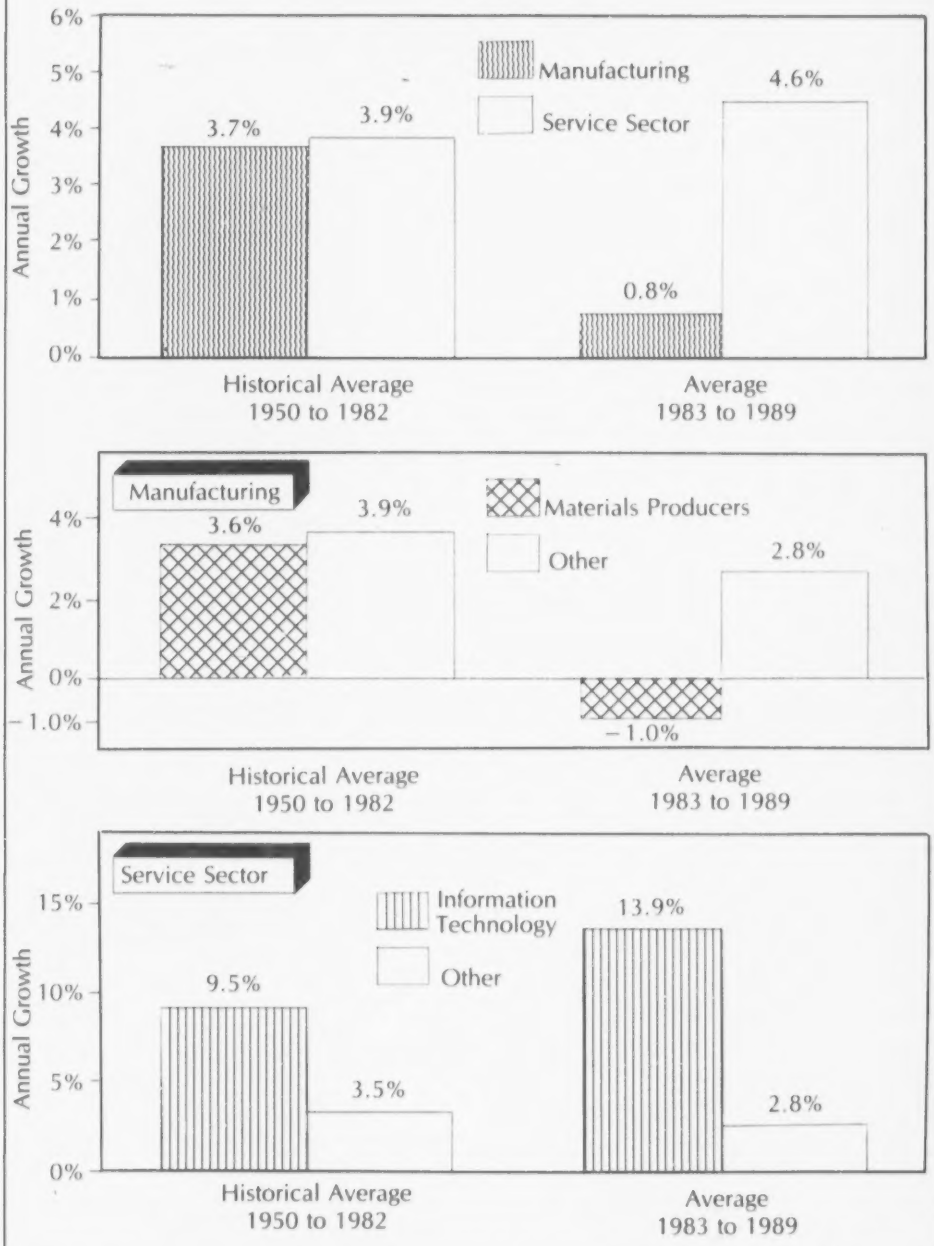
### *Shifts in Capital Formation*

A refocusing of U.S. capital formation, net additions to the physical volume of productive facilities, has been one of the hallmarks of the current economic expansion. As can be seen in Figure 17, the sharpest break from historical trends occurred in manufacturing, that segment of our economy with the most acute need for restructuring. For the factory sector as a whole, the rate of growth in the capital stock averaged only 0.8 percent per year in the period 1983 – 1989—less than one-fourth the trend rate of manufacturing capital formation that had been maintained over the preceding thirty-two years.[1]

As illustrated in the middle panel of Figure 17, the factory-sector capacity crunch was particularly dramatic for materials producers—industries

Figure 17

## Contrasts in Capital Formation




*Note:* Figures are net capital stock and are based on constant 1982 dollars. Materials producers include metals, paper, chemicals, leather, petroleum, rubber, lumber, and stone; information technology includes computers, telecommunication equipment, photocopiers, other office machinery, and scientific instruments.

*Source:* Morgan Stanley estimates based on the industry-commodity capital stock matrix of the U.S. Department of Commerce.

such as metals, paper, chemicals, petroleum, and stone. For this grouping as a whole, the capital stock actually shrank by 1 percent per year in the 1983 – 1989 period—a dramatic reversal following more than three decades of gains averaging 3.6 percent annually. In general, these industries have had the toughest time with heightened global competition, producing low-value-added commodities with increasingly antiquated production facilities. For materials producers, restructuring has entailed an outright retirement of redundant capacity.

Elsewhere in manufacturing, capital formation also decelerated in recent years. Gains in 1983 – 1989 were almost 30 percent slower than longer-term historical trends. This grouping is heavily dominated by the high-value-added producers of heavy machinery, information technology, and transportation equipment. For these industries, restructuring has necessitated a more cautious approach to capacity expansion; increasing emphasis has been placed on "de-bottlenecking"—investment aimed at alleviating the operational impediments of existing facilities. This segment nonetheless continued to increase its capacity at almost a 3 percent annual clip during 1983 – 1989—in clear recognition that an expanding volume of productive facilities is essential for maintaining market share in an ever-growing global economy.

In the service sector, capital formation took a different course.[2] As shown in the top portion of Figure 17, capacity growth averaged 4.6 percent in 1983 – 1989—nearly 20 percent higher than the longer-term historical average. However, as can be seen in the bottom panel of Figure 17, all the acceleration in services was due to surging investment in computers and other forms of information technology. Exclusive of these items, service-sector capacity growth in 1983 – 1989 actually ran 20 percent below its longer-term trend. Thus, to the extent that restructuring occurred in recent capital formation trends in services, it has shown up mainly in the form of a sharply increasing reliance on information technology.

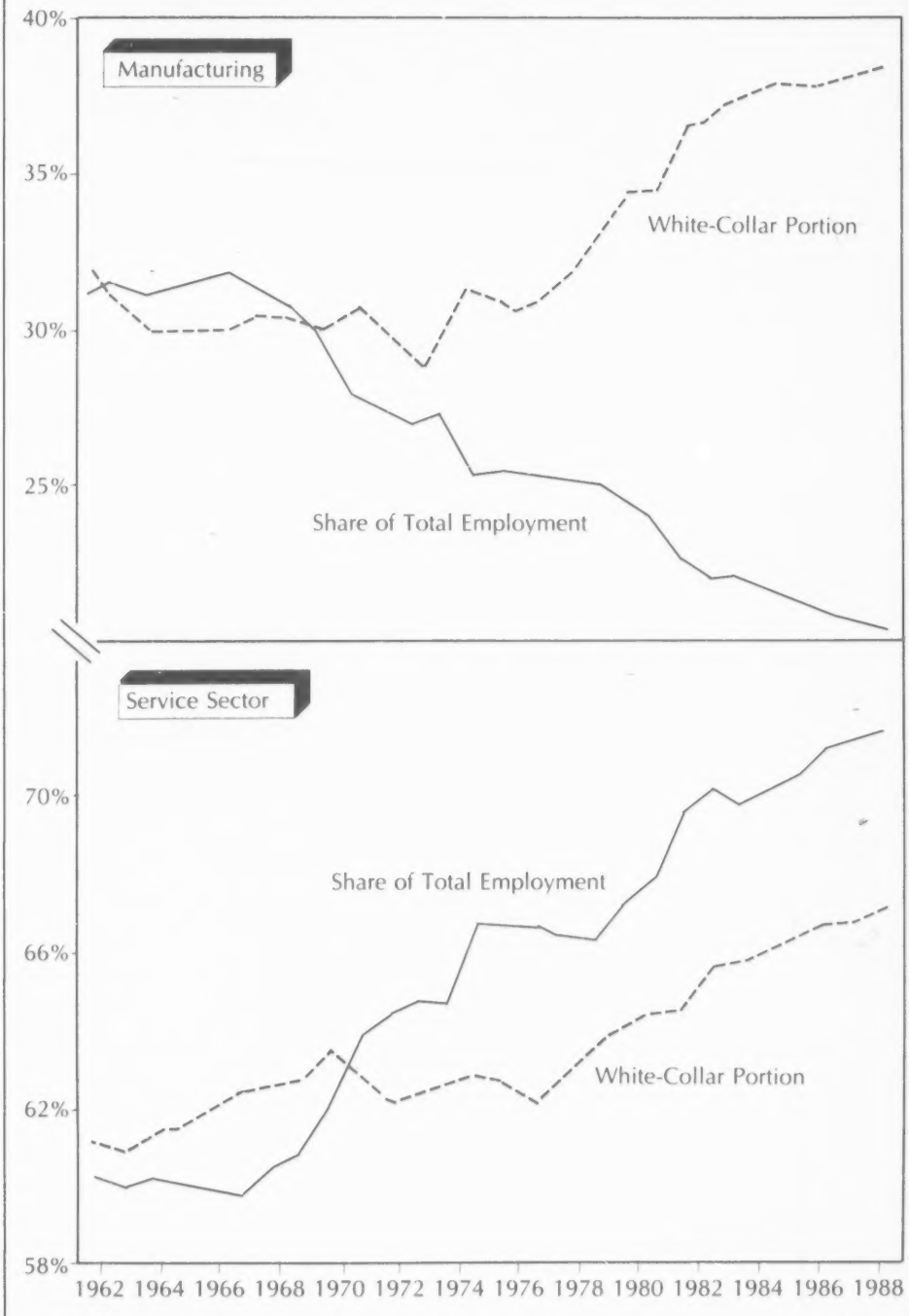
*Changing Employment Patterns*

A shifting of employment patterns is the other aspect of structural change that has played a critical role in shaping U.S. productivity trends. As can be seen in Figure 18, an enduring feature of job creation in the United States over the past twenty-five years has been a steady shift of employment from manufacturing into services. Indeed, as recently as 1967, the factory sector still accounted for almost one-third of total employment in the United States; today, that portion has dropped to about 20 percent. The service sector has picked up the slack, upping its employment share to almost 75 percent from about 60 percent over this same interval.

As for the impact of restructuring on recent employment trends, the manufacturing sector, not surprisingly, has borne the brunt of the adjustments.[3] As can be seen in the upper panel of Figure 18, the white-collar portion of factory-sector payrolls rose sharply in the early 1980s—implying

Figure 18

**Shifting Employment Patterns, 1962–1988**




*Source:* Morgan Stanley estimates based on the industry-occupational employment matrix of the U.S. Bureau of Labor Statistics.

a squeeze on the blue-collar share. Smokestack America's employment response to heightened competitive pressures has thus shown up more as a reduction of the assembly-line work force rather than as a cutback of managerial, administrative, and other office positions.

This approach to labor utilization provides one hint of what lies ahead on the road of restructuring. So far, efficiency corrections have been focused primarily on the factory floor, while reductions in the white-collar job count have been lagging. Indeed, our estimates suggest that white-collar employment costs currently account for 48 percent of total compensation expenses in the manufacturing sector.[4] That is a staggering bill for managerial and administrative employment—especially for industries where value added is focused mainly on the flow of the assembly line. Consequently, now that the blue-collar work force has been pruned of its redundancies, the focus of restructuring could now turn to the once-sacrosanct bastions of white-collar employment.

## SYNERGY AND TECHNOLOGY

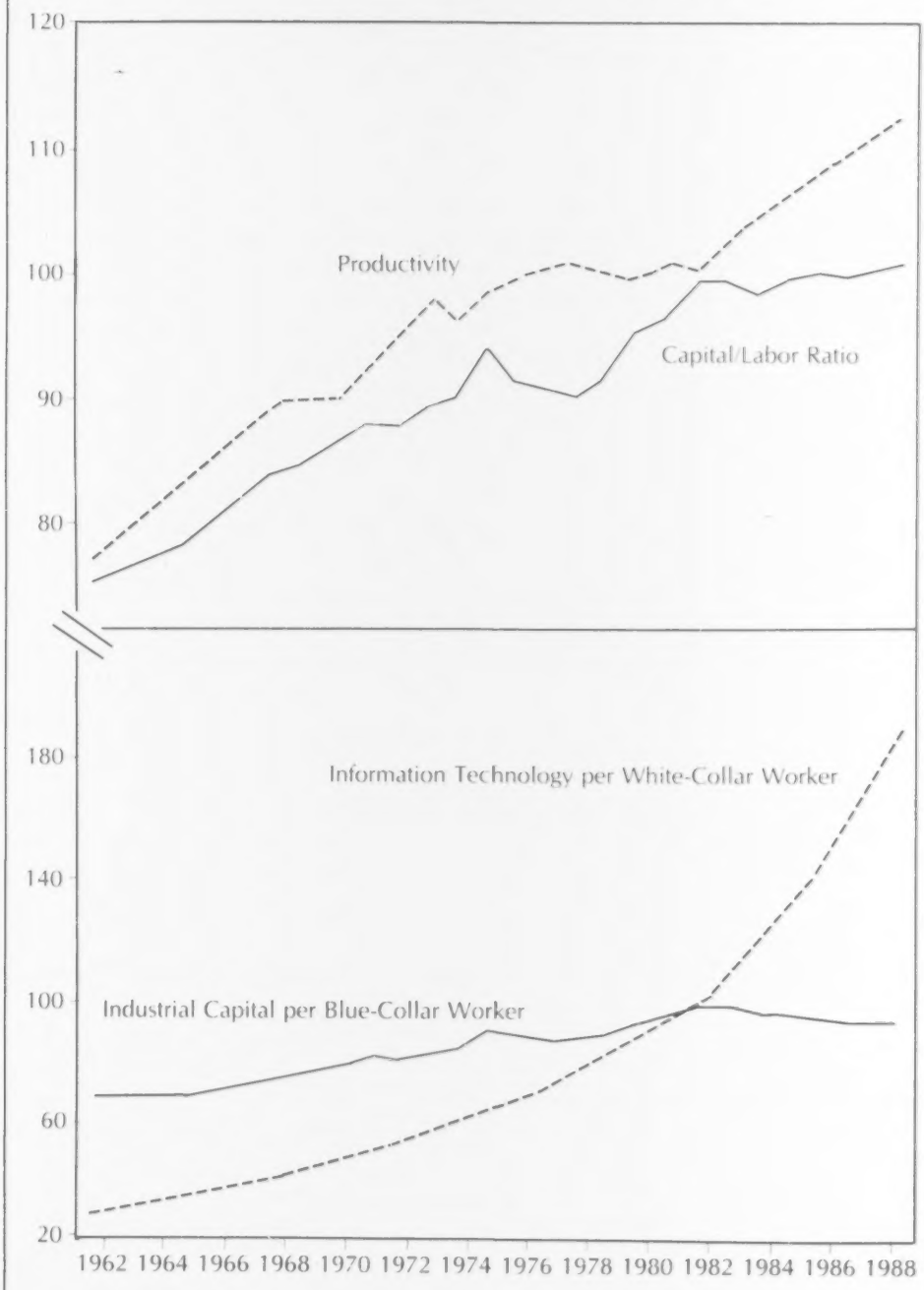
From the standpoint of productivity, shifts in capital accumulation and employment growth should not be treated in isolation. The linkage between these two inputs shows up in the concept of *capital endowment*—the amount of capital stock available to the average worker. A rising capital/labor ratio has long been recognized as a key to productivity synergy, as workers become increasingly equipped with the latest in technological breakthroughs that are typically embodied in the acquisition of new capacity. By contrast, sagging capital endowment puts the work force at a clear disadvantage in having access to new technologies.

Figure 19 presents the U.S. experience with respect to recent trends in capital endowment. As can be seen in the upper panel, trends in productivity and the capital/labor ratio have generally moved hand in hand over the past three decades. The flattening of capital endowment in the latter half of the 1970s was followed by a comparable shortfall on the productivity front. But then came a stunning, four-year rebound in capital per worker, and productivity began to respond. Interestingly, however, America's capital/labor ratio has expanded at a relatively sluggish clip since 1982, which suggests that the capacity-pruning aspects of restructuring have exceeded the efforts at controlling labor costs. Looking down the road, the pendulum will now have to swing the other way. If capital endowment is to move into closer alignment with our productivity objectives, capital accumulation will have to outstrip employment growth.

These aggregate trends mask an important refocusing of capital endowment that occurred recently in the United States. As can be seen in the lower panel of Figure 19, the sluggish growth in the overall capital/labor ratio during the course of the present expansion is largely attributable to outright

Figure 19

## Capital Endowment: The Link to Productivity




*Source:* Productivity index is from the U.S. Bureau of Labor Statistics; all other data are Morgan Stanley estimates based on the industry-commodity capital stock matrix of the U.S. Department of Commerce and the industry-occupational employment matrix of the U.S. Bureau of Labor Statistics.

declines in the amount of industrial capacity per blue collar worker, a rough gauge of capital endowment on the factory floor. At the same time, there has been a virtual explosion in the average white-collar worker's endowment of information technology; this ratio has almost doubled since 1982.[5]

This sharp increase in the use of information-processing equipment underscores the enormous bet that corporate America is making on the future sources of productivity enhancement. Capital endowment has been redirected away from its traditional focus—the factory assembly line. The emphasis instead has moved toward equipping executives, managers, and professionals—along with their vast cadre of office-support workers—with ever-greater amounts of computational and processing power. This strategic reliance on new technologies appears, in many respects, to be an unavoidable by-product of the Information Age. But this investment has yet to show much of a payback on the productivity front, raising serious questions about the strategy of restructuring in the service sector.[6]

## LOOKING AHEAD

While there have been ups and downs in recent years, the results of a decade of restructuring are generally encouraging. Most critically, manufacturing productivity has returned to its earlier trend after an ominous flattening in the late 1970s and early 1980s. And such improved efficiencies—in conjunction with a sharp depreciation of the U.S. dollar—have made U.S. companies more effective competitors in the global marketplace. Indeed, the U.S. merchandise trade gap fell to about $100 billion in 1990—a reduction of almost 35 percent from the record shortfall of 1987.

But much remains to be done. While the focus on manufacturing is certainly laudable, the pendulum of restructuring has long been destined to swing into the U.S. service sector. In this enormous segment of our economy, which clearly offers the world's richest and deepest service markets, inefficiencies have become almost endemic. That is all about to change. Global competition in services should intensify dramatically in the 1990s. Just as competitive pressures sparked the drama of restructuring in manufacturing, the service sector is about to be invited to the same party. And the next wave of restructuring will then hit with a vengeance.

## NOTES

1. We have argued that while this subpar pace of capital formation was an unavoidable by-product of the intense restructuring efforts of the 1980s, a resurgence of capacity expansion in manufacturing is essential if the United States is to maintain its leadership position in the global economy; see Stephen S. Roach, "Beyond Restructuring: America's Investment Challenge," *Economic Perspectives*, Morgan Stanley, July 14, 1988.

2. A discussion of capital formation in the service sector—and the dominant role played by information technology in shaping such trends over the past twenty-five years—can be found in Stephen S. Roach, "Technology and the Services Sector: America's Hidden Competitive Challenge," in B.R. Guile and J.B. Quinn, eds., *Technology in Services: Policies for Growth, Trade, and Employment*, National Academy Press, 1988.

3. In the United States, the service sector—despite its heavy reliance on information technology—has been less adept than manufacturing in realizing efficiencies in the composition of its work force. For a discussion of the sharp contrasts in employment trends between these two segments of the U.S. economy, see Stephen S. Roach, "Pitfalls on the 'New' Assembly Line: Can Services Learn from Manufacturing?" *Special Economic Study*, Morgan Stanley, June 22, 1989.

4. The calculations behind this estimate can be found in Stephen S. Roach, "Inflation Risk," *Economic Perspectives*, Morgan Stanley, May 1990.

5. The interaction between surging white-collar employment and the sharply increasing endowment of information technology is discussed in detail in Stephen S. Roach, "America's Technology Dilemma: A Profile of the Information Economy," *Special Economic Study*, Morgan Stanley, April 22, 1987.

6. Our estimates have long pointed to a very disappointing record for white-collar productivity in the services-providing segment of the U.S. economy—a sector that employs more than 83 percent of all white-collar workers and owns more than 85 percent of the stock of information technology. Indeed, our most recent calculations suggest that white-collar productivity in 1989 changed little from levels that prevailed in the late 1960s. See Stephen S. Roach, "White-Collar Productivity: A Glimmer of Hope?" *Economic Perspectives*, Morgan Stanley, September 16, 1988; and "Pitfalls on the 'New' Assembly Line."

# Enhancing U.S. Long-term Economic Growth

Michael J. Boskin

I'm pleased to have the opportunity to address your symposium, and I'd like to commend the American Council for Capital Formation Center for Policy Research for drawing attention to issues and trends in U.S. investment; to the U.S. long-term interest in saving, investment, productivity, and capital formation; and to U.S. long-term economic growth.

With the ink not yet dry on the budget summit agreement and the 101st Congress barely out of town, it is timely and important to consider several issues facing our country and economy—issues of particular interest to this group. Today I want to address primarily long-term economic growth—what we must do to enhance it and why it is important. However, I shall also say a few words about the short-term economic outlook, as it is receiving substantial attention. I shall try to put these topics in perspective.

I wish to start by giving a brief overview of why enhancing our nation's long-term economic growth is important. Economic growth sounds like an abstraction. Raising our long-term growth rate by just half a percentage point a year may appear to be very mundane. But when small differences in growth rates are compounded over a span of years, it makes a marked difference.

Consider a simple, yet stark, illustration. By growing only one percentage point less per year than France, Germany, and the United States, the United Kingdom managed to transform itself from the wealthiest society on earth to a relatively poor member of the European Economic Community in just a couple of generations. Long-term economic growth is probably the dominant factor in the success and failure of nations and certainly is the basic underlying source of improvements in the well-being of the general population.

Enhancing long-term economic growth is the key to ensuring America's future. Growth will raise our standard of living; it will create a legacy of prosperity for our children; it will ensure that we are able to afford nontraditional goods and services, such as a better environment; it will enable us to provide employment opportunities not only to the new entrants to the labor force, but also to those seeking upward economic and social mobility; and it will maintain our leadership role in the world.

These observations immediately turn our attention to the determinants of long-term economic growth. What must be done to ensure, enhance, and maintain that growth? But before I come to that, let me focus on what I call the "Myth of American Declinism."

Quite aside from the current short-term economic concerns—well before the economy had slowed and a possible recession loomed—we heard talk that America was in decline. We see it in newspaper stories, reflected in opinion polls, and in week-long series on national networks. We are told that America is already in decline, that America is lagging behind its economic competitors, that the collapse of our economy is just around the cor-

ner, that the United States is deindustrializing, and that foreigners will soon own most of our country.

There is one strong belief that I share with these pundits of declinism: We cannot take sustained, solid, long-term economic growth for granted. We have very serious challenges and formidable policy and societal problems to address if we are to ensure and enhance our long-term economic growth. I shall return to those in a moment.

Let me first try to debunk a myth about where our economy stands. We have had the longest peacetime expansion in the history of the United States. The short-term outlook is worrisome, but we should not allow headline descriptions of short-term problems to drive long-term policy decisions. Instead, let us consider facts: Despite the gloomy predictions from the pundits of declinism, the U.S. economy rests on a very strong long-run foundation.

With less than 5 percent of the world's population, we produce more than a quarter of the world's gross national product (GNP). We have the highest absolute level of productivity, by a large margin, of any nation on earth. We also have the highest standard of living, measured by GNP per capita on a purchasing power parity basis, of any major industrialized economy.

True, productivity growth has been more rapid in other industrialized countries than in the United States. In part, this reflects the fact that as these countries rebuilt after the war, their per capita incomes grew more rapidly. Some countries' per capita incomes that were 40 or 50 percent of the United States' are now in the 70 percent range. Still, it's clear we start from a preeminent position.

In addition, we are a large economy—the largest in the world. We are more than twice the size of Japan, the second largest economy. In 1989, we produced a larger share of the industrial output of the OECD nations than we did twenty years ago. That's true for a variety of reasons. Yes, our service sector has been growing, but it has been growing rapidly in other industrialized countries as well.

There is a misplaced notion that somehow our destiny is no longer in our own hands, that it is in foreign hands, and that this is inevitable. Our destiny is neither bleak nor predetermined. But we do have serious problems.

This brings me to the point of what determines long-term economic growth and what must be done to ensure, enhance, and maintain it.

Fundamentally, the growth rate of any country is determined by the rate of growth of its effective labor force and the rate of growth of productivity, or output per worker. Various factors can influence the effective labor

force, both in the short and long term. A labor force with more human capital, with better skills, is more productive. Similarly, you can have more workers, have more people decide to work in the market economy or work longer and harder, or have more immigration, to name a few examples. Increasing output per worker will depend not only on improving that worker's skills. It will also depend on providing that worker with the complementary resources to enhance productivity—specifically, new technology and the capital that embodies that new technology.

Over the last few decades, the United States' investment rate has been below that of other advanced economies. For two or three decades after World War II, it was possible to say this was a natural consequence of those countries rebuilding their capital stocks devastated in the war. Obviously, we had participated in the war and had casualties; but the war was not fought on American soil.

By the 1970s and 1980s, that explanation was wearing thin. We have too low an investment rate in the United States. We are not equipping our workers with new capital and new technology rapidly enough. So that leads to focusing on two important determinants of investment: the cost of capital and the rate of generation of new technology. Those two factors have an important symbiotic relationship. My own research and that of others reveals a complementary relationship between technological innovation and capital formation.

When new technology is generated, it is often integrated in the economy through new capital investments. Therefore, a high rate of investment means that new technology can be diffused rapidly throughout the capital stock, which enhances the productivity of workers more quickly. Even when Americans are responsible for inventing and generating new technology, if other countries have a much higher investment rate than we do, they will be able to generate and disseminate technology throughout their economy more rapidly than in the United States. This is a major concern.

I wish to address another critical determinant of long-term growth: investment in human beings. When I am asked to take a step back and assess the truly crucial long-term challenges confronting the American economy so that it maintains its position of leadership and enjoys sustained economic growth, rising living standards, and greater productivity two decades from now, I think that the number-one issue is the deplorable state of our elementary and secondary education system.

We spend more per pupil than any country in the world except Switzerland, and yet our children perform terribly on standardized, international tests. Our elementary and secondary education system is not delivering the goods. I do not mean to pat my former employers on the back by saying the United States still has the best higher education system in the world, but our K through 12 education system is falling badly behind, and unless we fun-

damentally transform it to improve our performance, our workers—the fundamental building blocks of the economy in the future—will not have the skills necessary in an increasingly skill-dominated international economy and will not have the skill to adapt to changes we cannot even begin to foresee now.

I see fundamental reform of our elementary and secondary education system as the number-one long-term priority in maintaining America's position as the world's leading economy. We cannot remain the world's greatest economic power unless we have a skilled labor force, and that is going to require great commitment and dedication. My own view, and the view of the administration, has been that fundamental education reform must focus on flexibility, choice, competition, performance, and accountability in the education system, on its output, and on how to achieve better output—rather than just on its inputs, or how much we spend.

With that off my chest, let me return to another of the three major contributing factors to long-term economic growth: investment. I have said that our investment rate has lagged behind that of other countries. Real investment has been reasonably good in the last several years. This is a story that is not often told.

If one looks at the ratio of nominal investment to nominal GNP, investment has not done all that well. But looking at real investment relative to real GNP reveals a different picture. These two rates differ because the price changes of investment goods have differed from the pattern of the GNP deflator of overall prices. Real investment has done better in the last several years; it has been running at a 17 percent rate, rather than at the 15 percent rate one derives from looking at the rates of nominal investment and nominal GNP.

A serious measurement issue is how the capital that investment generates is valued. For example, if you spend $10,000 on a computer today, you receive much more computing than you did from $10,000 spent on a computer just a few years ago. The real cost per unit of computing power has obviously fallen substantially. These issues of technologically embodied capital can be generalized to many other types of capital. However, it is perhaps most obvious and most extreme in computing and similar sorts of technology.

The question is, if investment continues to be the same share of nominal GNP, will we accumulate more capital, and will that capital be more productive in the future? The answer depends on how we measure and think about depreciation and obsolescence, and the generation, dissemination, and implementation of new technology. I am concerned that we have become complacent about investment, and, more importantly, I am worried that we are becoming complacent about our long-term economic growth.

We have had a long economic expansion. Perhaps it was natural, as jobs were created and incomes rising, not to pay much attention to fundamentals and to begin to take sustained growth for granted. But again, other countries are not taking their growth for granted. They are investing at higher rates. We need to rededicate ourselves to enhancing our long-term economic growth as our number-one domestic objective; a high rate of investment and major improvements in our education system are among the fundamental building blocks in doing so. We must also remember that the cost of capital is one of the primary determinants of investment.

The president recently signed a budget resolution that could be described as having controversial short-run implications. Let me just say that, for those who believe that deficits do not matter, I respectfully think you are wrong. Deficits drain the available pool of private savings for the nation's economy, raise the cost of capital, raise interest rates, and increase the difficulty of financing a high level of productive investment, which increases productivity.

In the mid-1980s, it was easier for the United States to finance a moderate level of investment partially with imported foreign capital. But the climate for capital around the world has changed markedly. Many reasons for these changes have nothing to do with the United States, for example, domestic issues with respect to the Japanese economy and financial markets, and, importantly, the changes that have occurred in Eastern Europe.

German unification will consume a substantial amount of German capital, as will other Eastern European concerns. That means it is going to be harder for the United States to finance additional investment by importing foreign capital, rather than by providing capital itself, over the long term.

In this new climate, getting the budget deficit on a downward path and reducing the rate of debt accumulation was and is, in my view, a fundamental part of our long-term growth strategy. Once we go beyond the short-term issues with respect to the Persian Gulf that are driving our interest rates today, the budget agreement will lead to a decline in interest rates and, over the long term, to an increase in the rate of investment.

There is much misunderstanding about the budget agreement, and there are many people who really do not fully understand what is in it. Let me just briefly say a word or two about that.

First of all, this new budget law is vastly larger, more complex, and a lot tougher than anything that has ever been done before. It will achieve almost $500 billion of savings over the next five years, relative to what it would otherwise be. The bulk of the savings will come from the spending side. In addition, the agreement imposes major new enforcement procedures on Congress that will make it much more difficult for Congress to raise spending and violate the budget law.

This budget agreement reforms the budget process, is much tougher on enforcement, and closes a lot of the loopholes that existed under previous law. For example, rather than a yearly snapshot, under which the Gramm-Rudman-Hollings law operated, there are three different, so-called sequesters, or automatic spending cuts, which reduce spending when Congress goes over the spending caps. This and other procedural reforms will restore some rationality to the budgeting process.

As people come to understand the new budget law, they will appreciate how much has been accomplished. And as financial markets come to acknowledge fully the budget process reform, and how difficult it will be for Congress to violate the law, interest rates will come down over the long term.

I want to say one or two more words about budget deficits. How the government spends its money and how it raises its revenues are equally important. It is not just the difference between the two that counts. For those who say that deficits do not matter, I say that is nonsense. For those who say *only* deficits matter—not how much you spend, or how you spend it; not how you collect the revenue, or how much you collect—I say that is nonsense as well.

We are going to continue to push for a reorientation within the spending caps, toward investment in productive public investment in research and development, and infrastructure (but only proposals that pass serious, tough cost-benefit tests) and away from current consumption.

Let me summarize: I have reviewed some assertions from the pundits of declinism; I have emphasized long-term growth; and I have stressed the importance of improving our education system and raising our investment rate and the role that budget deficit reduction reform can have in reducing real interest rates over the long term and raising investment. Before concluding, let me say a word or two about the short-term economic outlook.

The economy has clearly slowed. There is no doubt about that. It has grown sluggishly for the last several quarters. The third quarter of 1990 was moderate: 1.8 percent real GNP growth, and some moderate strength in business investment and relatively small inventories. But the data for October have been weak thus far, and we expect that the substantial hit to the economy from the oil price increases resulting from the Iraqi invasion will show up most in the fourth quarter of 1990 and early in 1991. So superimposed on a sluggish economy, we now have an oil shock, though one not nearly as large as those of the 1970s.

The goods news is we are better able to deal with an oil shock than previously for a variety of reasons. First, the price increase to date has been substantially less than the real price increases in the 1970s in proportionate terms. Second, we use one-third less energy per dollar of GNP produced

than we did in the early 1970s. And importantly, we have dismantled much of the foolish regulation of the 1970s, which took a bad situation and made it radically worse. It is important to avoid repeating those imprudent mistakes. I can assure you that this administration is committed to avoiding a replay of those failed policies.

Once the Middle Eastern situation is resolved, oil prices will come down. Exactly how long the current situation will keep oil prices high is difficult to forecast. It depends, fundamentally, on geopolitical, diplomatic, and, if necessary, military issues and decisions that transcend short-term economic issues. We have to do what is necessary to address Saddam Hussein's aggression.

So, at least publicly, I am no better able than most of you to say what is likely to happen in the Gulf. I can say, looking past the oil shock, that the economy will rebound. After this hit to real GNP, and temporarily higher prices that cause the measured inflation rate to go up on a one-time basis, the inflation rate will fall again and real GNP will rebound.

Our current economic forecast, which we shall be revising soon, had allowed for a slowdown in the fourth quarter this year and early next year. It is consistent with even slipping into negative territory this year. It is also consistent with shallow, slow, positive growth next year, or a more sluggish or a negative early period next year, followed by a more rapid pickup.

As we get more information about the situation in the Middle East and the direction of oil markets, we shall be able to refine our forecast. In any event, the economy, *at best*, is in a lull. I expect that lull to be relatively brief and relatively mild. It should be at its worst—perhaps negative real GNP growth—in this quarter and next.

In conclusion, we must renew our attention to enhancing our long-term growth. A lot of things will occur naturally as the economy self-corrects from its short-term slowdown. Many factors have contributed to the slowdown in addition to the oil shock. These include a tight monetary policy, tight credit conditions, the rise in interest rates in the early part of the year as world capital markets witnessed the decline of Communism and collapse of the Berlin Wall, and the new demands for Germany to pour massive amounts of its previously exported capital into the former East Germany.

To be sure, the short-term forecast is more uncertain than normal, because we just can't say for sure what the size and duration of the oil shock will be. I think we are better prepared than we have been in the past for it. But it does come at a time when the economy is growing more slowly. It also, happily, comes at a time—unlike the 1973 – 1974 shock, and 1979—when inflation is substantially lower and not rapidly accelerating.

I don't want to paint an overly optimistic picture. The economy cer-

tainly is in for a rough couple of quarters at least. But I do want to draw your attention, again, to the fact that after this lull, the economy will be picking up. My best guess—and again, at this point, it's only a guess—is that growth will pick up some time around the middle of 1991.

I want to conclude by thanking the ACCF Center for Policy Research for all the work it is doing to enhance and ensure long-term economic growth. Thank you for your attention.

Published by: American Council for Capital Formation
Center for Policy Research
1850 K Street, N.W., Suite 400
Washington, D.C. 20006
Telephone: (202) 293-5811
Facsimile: (202) 785-8165

Editor: Donna L. Brodsky
Design: Maria Claudia De Valdenebro
Typesetting & Print Production: AAH Graphics

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Price: $15.00

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